Qualifications and Curriculum Authority

Evaluation of participation in GCE mathematics

Appendix J: Case study centre staff interview report 2006

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Case study centre staff interview report 2006

In March and April 2006 mathematics teaching staff at 17 of the 19 case study centres were able to take part in interviews about their experiences of A level mathematics. In total, 50 staff were interviewed in small groups on location in their centres. Fourteen heads of department and eight deputy heads of department were available for interview at 15 of the centres. All the awarding bodies for A level mathematics are represented in the sample of 17 centres. Four of the centres were offering the AQA A level in mathematics, eight were offering Edexcel, five were offering OCR and two were offering OCR's MEI A level in mathematics. Fourteen of the 17 centres were offering the A level in further mathematics (FM).

The new A level

The teachers were asked a general question about their experiences of A level mathematics this year. They made a number of comments that suggest they had changed their provision in response to the new A level and were now familiar with the new requirements and more confident about teaching the course. Some of the centres reported that larger or much larger numbers of students were now studying AS mathematics or continuing to A2. Some indicated that students with a wider range of abilities were choosing AS mathematics and continuing to A2. One said that this included more GCSE intermediate tier students, who seemed to be coping. Some of the centres made comments about time. Most said that there was now more time to complete the course and welcomed this change, but a few centres made conflicting comments about a lack of time or too much time for C1 and C2, perhaps reflecting different levels of ability between their cohorts. Some of the teachers made comments about the combination of A level mathematics or further mathematics units. One said that they reduced their offer of optional units because of the reduction in application in the new A level. A few made comments about the FM units and these were wholly positive, relating to their increased flexibility and logical sequencing.

Exam results, summer 2005

Six centres had found that the AS results from the summer 2005 series were higher than expected. For five centres they were lower than expected. Three centres reported that the results had met their expectations. The responses of two centres were less clear cut, with a mixture of good and disappointing results.

Most centres (nine) reported, sometimes tentatively, that the A2 results for summer 2005 were for the most part better than expected. The results of only one centre were as expected and only one centre had found that results were lower than expected. Five centres had continued to use the old specification at A2, changing to the new A level in September 2005. One centre was not able to give a response. One respondent reported that C4 was much more difficult than C1, C2 and C3 and felt that a different approach to the questions is required.

Morale

Student morale was predominantly positive. The general view was that mathematics is a tough A level but that students were generally coping well and that student attitudes were good despite time pressures. In a few cases good student morale was attributable to good results or to the improved content in the core modules, although one school said that students who had moved on to C2 were recognising that C1 had been easy.

In some cases, improved morale at AS was specifically mentioned without prompting. In other cases, teachers noted that the high morale of their students did not necessarily equate with high motivation and hard work. Comments were negative from only one interview, and only mildly, with one teacher reporting that year 12 students were feeling the pressure of taking two core units in their first year.

Staff morale was mainly expressed positively, with comments such as ‘good’ or ‘fine’. A few expressed spontaneous enthusiasm for teaching the subject, the A level or their classes. Just a few centres were finding that there was not enough time to cover all the course content. One teacher felt that it was not straightforward to cover all of the AS in one year. The implication of these comments is that if these teachers had more time to cover the content then they would feel better about their role. In a couple of cases, there were morale problems because of internal resourcing and management. One set of teachers disagreed with the external evaluation of their A level mathematics provision and this was to some extent impacting negatively on morale.

Entry criteria

The centres generally require at least a grade B in GCSE mathematics for progression onto A level mathematics. Most of these centres accepted B in higher or intermediate tier but some accepted only students with a B in the higher tier.

The centres were generally using the same entry criteria this year as last year. Only a couple were clearly using different criteria. One centre now requires all students to have a grade A in GCSE mathematics and another centre now accepts higher grade Cs but not intermediate grade Bs. A third (a further education college) now requires a B, where previously they would have accepted a C.

Progression criteria

Some centres do not have ‘formal’ criteria for progression from AS to A2 but rather rely on students to decide whether it is wise to continue beyond AS. Some centres do require a pass at AS but others discuss the situation with each student.

On the whole, the centres were using the same criteria for progression from AS to A2 mathematics as in the previous year. In only a couple of cases had centres changed the criteria, with the effect that only students who had passed the AS modules could continue to A2.

Two-tier GCSE pilot

One of the centres participated in the pilot of two-tier GCSE mathematics. This centre’s head of department took the view that the pilot would not have an impact on A level mathematics, as the centre’s entry requirement would continue to be grade C or above.

Some of the centres not involved in the pilot gave their views of the possible impacts of the two-tier GCSE on A level mathematics. A few of the teachers interviewed were expecting more higher-tier students and therefore more students considering mathematics as an A level option.

New specification structure

Almost all centres commented on the changes to the structure of the qualification, most of them being broadly favourable.

Several expressed support for the higher proportion of pure mathematics in the new syllabuses, although a minority dissented, arguing that the new structure offered less flexibility and: ‘The applied part of the course has been diluted'. Doing a second pure mathematics module in the first year made the course

harder. ‘The A level is now two-thirds pure which they find hardest. The government wants more mathematicians; they are not going the right way about it!’

There was general support for the lower emphasis on mechanics, as fewer students now go into physics; statistics is more relevant to other subjects, for example to geography and economics.

There was also general agreement that mathematics required more time than other A levels and was viewed as more difficult. It was felt that the recent changes had reduced the gap between mathematics and other A Levels, although only one centre felt that the time required for mathematics was now ‘on a par with other A levels’, and one considered that the total content had increased.

One centre queried why the content of the C1 to C4 modules differed between the different exam boards.

Content of the new specification

Staff were asked to react in detail to the content of the new A level.

C1 is widely seen as a ‘transition unit’ between GCSE and C2, with some overlap with GCSE content that provides useful repetition, refreshes students’ understanding and provides a gentle introduction to AS level. Some, however, thought the repetition was excessive and C1 too easy. At several centres, it was thought that there was too much time for C1 and not enough for C2 or that C2 was too big a step up from C1; some had changed the time allocations to address such concerns. At one centre it was felt that there is no longer enough content in terms of both breadth of topics and depth of understanding to challenge their students, who are generally very able mathematicians.

There were a number of detailed comments and suggestions relating to the C1 and C2 syllabuses:

> 'The circle stuff in core 1 seems to sit rather oddly.'
>
> 'Logs should be in core 1. The integration is very basic.'
>
> 'There should be some trig in core 1, and curve sketching should be put into Core 2.'
>
> 'Why did they add in Simpson’s rule?'

'The first year's doing binomial on C2, but some of exam questions are really second year standard.'

'The old syllabus had second order differentiation in pure 2, differentiation in core 1; now both are in core 2 so they don't need curve sketching to find turning points. This also means that they haven't met differentiation, which they need for mechanics 1.'

'The series and sequences work in C2 is disjointed. They cannot complete the geometric progression work because they have not studied logs.'

'In core 2 the trig chapter containing the cosine rule, the sine rule, and the area of triangle seems to have been fitted in. So far this work has not been tested and students have been asked instead to solve trig equations as they were before. The cosine and sine rule should be in core 1 rather than core 2.'

'Even and odd functions need to be emphasised by the teacher in core 2 as they are examined, but they are only mentioned in passing in the textbooks.'

'Arithmetic and geometric progression should be together in C2.'

Those mentioning C3 generally felt it was overloaded, and some suggested that the topics did not relate together. Several spoke of the need to move some of the content of this unit into the other core units. One centre suggested moving some of the material on functions into C4 and another suggested moving all of functions into C4. Two centres suggested similar changes to trigonometry.

As with C1 and C2, there were some specific comments:

'The calculus of C3/4 is needed for M2 and this can cause problems juggling round the syllabus.'

'C4 includes skills, for example algebraic manipulations, which should be in core 3.'

'C4 is very integration heavy; "they find calculus very difficult".'

'Some topics have been removed from the pure, for example vector equation of a plane and Cartesian equation of a line.'

Mechanics

One teacher liked M1 because of the way that it is ordered: 'It progresses nicely and links topics'. One thought that the reduction in content in M1 makes it more accessible. She had heard that Newtonian mechanics is not taught at university and wondered whether it should be replaced in the A level syllabus by more modern concepts.

Another would prefer projectiles not to be in M1.

> ‘The loss of the M3 content has been a factor in the improved grades but, from a teaching point of view, it is a pity to have lost the challenging work. Cambridge prefers as much mechanics as possible so [the school has] introduced M3 as a fifth application unit for further mathematics students. In future the teaching of this module will be an issue with newer teachers who have had no experience of teaching mechanics. Initially, D1 was used as the fifth application unit for further mathematics students but the students did not like it.’

Statistics

There were several positive comments about the relevance, manageability and variety of the statistics modules. ‘Students are enjoying statistics 1; there is a general positive attitude because it is do-able.' The greater emphasis on interpretation in the questions was good but difficult for overseas students.

One Edexcel centre said that the probability examples are badly explained in the Edexcel textbooks.

There were some concerns over detail:

> 'Too much GCSE material is repeated.'
>
> 'There should be more interpretation of graphs instead of drawing graphs.'
>
> 'There should be more use of diagrams.'

Decision mathematics

Two staff regarded this topic as trivial. Most interviewees who commented saw it as accessible, with students enjoying it and ‘seeing the point’. The focus on interpreting answers was good. One thought it was too easy and boring for more able students, but another said: ‘The decision 1 course is difficult and the students struggle with motivation as they can’t see the point of some topics’.

One teacher said that in D1 the linear programming is divorced from the other parts.

One centre had dropped D1 because ‘the exam boards could not get the lengths of the exams right, the results were low and it was lengthy to teach'.

Further mathematics

One teacher was concerned that FP4 contained some completely new topics, for example transformations in 3D, vector cross product for areas and volumes. There is no textbook specifically written for this.

Staff from another centre said that those students who plan to study mathematics at university are expected to take further mathematics. However, they felt that this is not sufficient preparation as the qualification can be gained by doing ‘extra applied’ modules, ‘for example D1’.

Some teachers thought that there had been a dilution of standards in FM: ‘The current further mathematics included topics which would in past years have been part of the single A level specification’.

One teacher also tutored students who were sitting further mathematics with other boards where the FP1 unit is not dependent on knowledge from C1–4. She regretted that Edexcel do not do this, because it would enable them to start some interesting ideas in year 12, for example 2x2 matrices. ‘It is a shame that the Edexcel specification does not allow them to deliver AS further mathematics in year 12.’

Content issues

Teachers were asked about the new approach of introducing a topic at AS level, with a more sophisticated treatment of the subject at A2 (the ‘spiral curriculum’). Staff at almost all the centres regarded this positively, considering that it enabled staff to reinforce and build on what they had already taught. Sometimes it enabled them to show the link with topics from other modules, for example linking mechanics to integration. It was particularly helpful for weaker students. They conceded, however, that students did not always make the connections, and that it was necessary for teachers to point out where a lesson was building on previous work. Students also need to see a use for the techniques. So, for example when teaching the technique of integration (C4) teachers needed to explain how it could be used, as this would only be taught later in the course. A few staff made neutral comments or regarded the change negatively;

the main criticism was that the course became fragmented.

One independent school was still using a linear approach to teaching and not sitting AS levels, but they planned to revise their teaching scheme for next year so that they would not be covering significant A2 material in year 12. Another school was only partially following the recommended approach.

Exams

A number of the staff interviewed mentioned differences in the exams for the new A level. Several thought that the exams are more accessible now and a couple mentioned C1 in this context. Opinions differed as to whether 'more accessible' meant a lower standard. One selective independent school was very critical of the change, saying: 'They should return to a qualification designed for mathematicians. There is not enough content, not enough demand within the questions and insufficiently demanding algebra'. A further education college also said there had been an unwelcome reduction in the standard.

Some teachers said that the exam papers are now better structured, with more short questions. Two OCR centres complained that the mechanics paper had changed and was now more difficult to understand. One Edexcel centre also considered that the mechanics questions were not as expected from the textbook. Two centres argued that questions should be graduated, with easy questions at the beginning and some more difficult questions to stretch the more able.

Three centres commented favourably on the introduction of non-calculator papers. Two complained about the total examination/assessment time.

Transition: GCSE to AS

There was general agreement that the easier C1 module and the repetition of topics covered in GCSE meant that transition from GCSE was easier than in the past and progression was smoother. This meant that weaker students were less likely to drop out, although one teacher suggested that this was a disadvantage, as they would struggle later, when a course change would be more difficult. Brighter students could also experience some problems during year 12 as they were accustomed to sailing through GCSE mathematics without needing to do much work.

One transition difficulty was stated to be that students had not covered the whole GCSE syllabus. It is not clear whether this referred to students who had done well on the intermediate tier in GCSE, who other centres thought likely to struggle on AS level. One school felt that students transferring to them from other centres after GCSE were inadequately prepared: 'Their understanding of the processes of mathematics is non-existent.' A further education college also had concerns about the quality of the GCSE course as a preparation for AS level.

A number of centres still provided short transition programmes for all new year 12 mathematics students and others provided special bridging work for those who had done intermediate tier at GCSE. Others chose to teach statistics before mechanics, as students found it easier.

One school said: 'A* students have no difficulties. Weak grade A GCSE students will struggle'. However, this was an independent school and conceded that they expected all their mathematics students to get at least a grade B at A level, so the pace of work was correspondingly higher.

Another independent school said that students with grade B at GCSE struggled because they had a lesser understanding of algebra. Students coming from other schools with good GCSE grades also struggle because they are not accustomed to thinking for themselves. 'Students still think that it is a big step and for some of them it really is. This is the fault of the system because we play the game of how to get the best mark at GCSE instead of teaching them mathematics properly. This is a fault of the whole assessment policy.'

Transition: AS to A2

Although some weaker students would have dropped out before the second year, centres agreed that the transition to A2 was often difficult: 'It is quite a shock to them when they start A2;the topics get significantly harder and they don't expect that'. The AS course was relatively easy and that meant that there was not much to build on for the A2 course. Students who had lower grades in their AS modules were (unsurprisingly) more likely to struggle.

The transition was made more difficult by the time gap between the two years: 'Students unlearn everything they learned at AS over the summer'. Although schools started A2 teaching at the end of the summer term, there were interruptions for many students because of field trips in other subjects.

Some centres would like to see the AS exams later in the summer term, although this seems unlikely to address the problems of the summer break.

Two independent schools taught A level as a two-year course (without taking the AS exams) and were not concerned about the AS to A2 transition.

Accessibility for the less able student

The majority view was that the new A level specification was more accessible to the less able student. Two people said this was because the level of prior knowledge needed was lower. Also, while the old AS level had required far more time than other AS levels, the new specification corrected this. A minority had not found the new syllabus more accessible. One school thought that this was a result of the way they had structured the course. Two thought that the content was too abstract or too weighted towards pure mathematics. Two said that students who had progressed from the intermediate GCSE tier or who were taking mathematics as their fourth subject were finding it difficult.

Most people approved of the more accessible AS level, accepting that it was desirable for more students to be able to take mathematics at this level. They considered that the new recruits to A level mathematics would probably not be the most able but would still be able to benefit. By contrast, one teacher was strongly opposed to a reduction in standards and two doubted the value of a more accessible AS level, arguing that the less able should take an alternative course such as the use of mathematics or statistics.

By contrast, everyone who commented on further mathematics, thought that this should be designed for the mathematically most able.

When asked whether a student who was not naturally gifted could become an exceptional mathematician, most said that such a student could do as well, or almost as well, through hard work as a gifted student who did not work. A minority thought that the ‘slogger’ could achieve well but not get the highest grades and/or not achieve at further mathematics. The slogger would never have the flair of the really able.

The general view was that increased participation required not only a more accessible specification (which the new one was) but also better teaching and better grades at GCSE to boost confidence. Success at AS

level further boosts the confidence to continue to A2, although some will stop after AS. The press was partly to blame for the low take up, by fostering the image of mathematics as a hard subject and the situation was not helped by other professionals 'who proudly say they were never good at mathematics'.

Many interviewees thought that an increase in numbers at AS and A level would lead to an increase in numbers going on to do mathematics in higher education (HE), but several disagreed or were unsure. In any case, the increase in HE was expected to be smaller than the increase at A level, because most of the brightest mathematicians would have gone on to HE previously and also because there were many other interesting HE courses competing for students with mathematics. Some centres were beginning to see a small increase in students going on to either a full mathematics degree or mathematics in combination with another subject. Greater participation in A level mathematics should also increase the numbers going on to other subjects for which mathematics was needed.

Should A level mathematics be only for the 'clever core'?

With three exceptions, interviewees believed that mathematics should be available to students within a range of ability similar to that for other A Level subjects. The clever core should be encouraged to do further mathematics as well and given additional stretch as described in the next sub-section. However, smaller schools could not always support further mathematics and extra funding was needed.

Several centres reported increasing enrolments for AS level mathematics, with a wider learner profile and an increasing belief amongst students that it was not only the clever core who could succeed. Several divided their post-16 mathematics students by ability; almost all made extra provision for the more able. They noted, however, that the inclusion of too many weak students tended to depress standards amongst the others.

Stretching the most able

Most centres had a range of ability in their mathematics classes. It was suggested that there was enough material in the new specification to stretch the 'normal able' student, but that the most able could be stretched only by doing further mathematics A level. Some centres had increased the numbers on their further mathematics courses to provide the necessary challenge and one also offered AS further mathematics as a less demanding extension, but one did not have enough staff time to do this.

Some suggested that A Level exam questions should be designed so that the final part was accessible only to the most able.

Centres were using additional questions in the textbooks to provide stretch, as they went beyond the requirements of A level. They were also using the AEA, the UK Mathematics Challenge, mathematics poster competitions and inter-school mathematics quizzes, encouraging the more able to 'read around' the subject and using links with employers to help students to see how mathematics was used in the real world. One put the brightest into sub-sets so that they could stimulate one-another.

The great majority felt that they could meet the needs of a wide ability range by providing extension activities of these kinds to the most able, setting more demanding targets for the most able and also providing extra help for those who were struggling. One centre, however, considered that the weaker students should be able to do a 'mathematics for business' type course instead of the normal A level.

A number of centres were offering A Level courses which included all three of S1, M1 and D1 and not the harder A2 units. In part this was to maximise results (both for the centre and for the individual), but it also provided a broader grounding for further study. Sometimes it was driven by timetabling problems.

There were some suggestions that the choice of units within further mathematics could make the course less challenging than it should be. One teacher commented that it was often 'more mathematics' rather than 'further mathematics'. Another centre, however, reported choosing a more difficult unit once they had established that their students were not relying for their HE entry on getting a top grade in the subject.

Recruitment and retention issues with the new specifications

At some centres teachers said that it was too early to assess the effects of the new specifications on recruitment, but several said that there had been an increase in September 2005 and one was expecting a larger intake in September 2006.

Several staff said that news was only just beginning to spread that the new specification made A/AS level mathematics more accessible, although they expected that this would eventually have an effect. Mathematics was still, however, seen as a subject that was hard, though useful. Others pointed out that other factors were important in recruitment, especially good teaching and good results in the GCSE year.

Four centres reported a lower drop-out rate in year 12 during 2005/06 than previously and three said that progression into year 13 mathematics had improved in September 2005.

Four centres said that they were actively trying to raise recruitment to post-16 mathematics. Three said they were not trying, one of these – an independent Hindu school – said they had no need to promote the subject: ‘A level mathematics is culturally a natural subject to study’. Two felt that extra recruitment was constrained by their existing policy on minimum entry requirements for mathematics.

For a few centres, increasing recruitment was more about fending off competition from other local providers, but others were making definite efforts to widen participation. Methods used included: offering either C1 or additional mathematics GCSE to the top set in their GCSE year; providing a bridging course from the intermediate GCSE tier; interest-raising talks either in-school from visiting speakers or at a local university; taster sessions for pupils from feeder schools; taster topics in the GCSE year; and ‘we have livened up the classrooms’ (it was not clear whether this meant décor or lesson style).

Eight centres said that they had the capacity to take more mathematics students, but three could not increase their intake, or only with difficulty.

No centre had a clear policy of using different messages to appeal to girls and boys, even though two mentioned a need to recruit more girls; some said that the message had to be the same for all. Few commented on the likely differences in the attitudes of girls and boys. One suggested that boys choose to do mathematics because they like it, while their girls tend to be more focused on their plans for the future. Another suggested that the students who succeed tend to be boys who understand concepts straight away and girls who work hard using all the support available.

At several schools teachers said that policy did not allow them to try to ‘sell’ one subject to pupils in preference to others.

Those who were allowed to promote their subject ‘sold’ mathematics as a very useful adjunct to other subjects, especially physics, as a qualification that demonstrates your ability to think logically, as a subject which impressed employers and higher education admissions tutors and as a route to earning 20 per cent more money. One centre, a well known London school with a high A level mathematics entry, said that mathematics was now being combined with a wide variety of other subjects, not just the ‘traditional’ science choices, suggesting that the value of mathematics was increasingly recognised. Another school

stressed the usefulness of mathematics for business students.

One centre said that they told pupils that enjoying mathematics, being good at it and seeing its value for the future were all good reasons for choosing to study it, whereas ’because I cannot think of anything else’ and ‘parents said I had to’ are not adequate reasons.

Three centres mentioned giving special encouragement to the top set to carry on with mathematics. Another suggested that the government should take the lead, by pushing the value of taking post-16 mathematics to pupils before the age of 16.

At one centre staff said they would like to offer more flexible options to cater for those who would struggle with the full course, for example a two-year AS level or taking M1 as a stand-alone unit for physics students.

According to the interviewees, an ideal mathematics student is one who:

- is good at mathematics and hard working
- does all the homework, takes good notes, has a good work ethic, listens to advice, willing to have a go and does not laugh at the teachers' mistakes
- is willing to have a go, asks for help when struggling and keeps on practising
- is conscientious and hard working and has strong algebra
- is hard-working and prepared to put in extra hours if she is weaker
- is committed and enthusiastic/passionate and likes to solve problems
- has an A* (OR at least an A) at GCSE
- enjoys mathematics; if you don't enjoy it you don't do well
- is willing to gamble and likes to take risks
- does not regard mathematics as a book subject, which just has to be regurgitated.
- ‘laughs at my jokes’.

Time allocations

With one exception all centres said that the time allocation for A level mathematics was the same as for other subjects, quoting figures in the range 8–10 hours per fortnight. The exception said that they had chosen to have one fewer lesson (eight instead of nine) in year 13 in order to release staff to teach further mathematics.

Retention strategies

Centres had a range of strategies for retaining students who were struggling with the course, including one-to-one discussions and monitoring, revision days, workshops (for example compulsory workshops for those who failed the C1 mock exam) and resits in year 13. Two centres, however, (one an independent school and one a community technology college) said that they did not want to retain the less able and four said they did not have a retention problem. One said that they encourage struggling students to continue, but emphasise that they are not failures if they do drop mathematics. Another said that drop outs during the year were extremely rare; between AS and A2 students had a discussion with teachers in the light of their results, but the final decision rested with the student**.**

Both further education colleges indicated that the central enrolment system meant that unsuitable students (for example one with only a grade C at GCSE) were occasionally enrolled for mathematics because the departmental staff were not involved. One of these colleges said that students have the opportunity to re-assess their choices after three weeks; those who want to drop a subject go through interviews with their personal tutors and their subject teachers.

The same college said that, although they aimed to provide workshops and remedial classes to students who were struggling, the college's acute financial problems had forced them to cut remedial classes and delay workshops until later in the year.

Use of further mathematics

Fourteen of the 17 centres interviewed taught further mathematics, with one other centre saying they would provide it if there was a demand and if it could be timetabled. Only two centres said they offered the MEI (Mathematics in Education and Industry) further mathematics course.

Eight of the centres offering FM started the course in year 12; one of these offered FM only at AS level. Those who gave details of their arrangements said that students took three FM modules in that year in addition to their single A level modules. Several of these said that FM students and single A level students were taught together for common modules. One centre with very small numbers had flexible arrangements for FM, which varied from year to year.

Five of the centres offered FM only in year 13, after students had done an accelerated year 12 course, completing the single A level either in one year or in just over a year. One of these centres offered FM only as an AS level; another offered both AS and A level.

Only one centre was a member of the Further Mathematics Network, although two had some links with an FM member nearby, one had applied to join and not received a reply and one was considering involvement.

Only two centres made any use of distance learning. One used it for students taking mathematics as a fifth A level, but suspected that the group was not doing much work. The other centre offered distance learning not to its own students but to those from other schools. One centre appeared not to have heard of the distance learning.

Five centres required an A or A* at GCSE for entry to further mathematics. For one of these this represented a change from the previous year when entry was by individual negotiation. This centre also required an A or B at AS level, where students were coming from the accelerated group; another centre required a good mark on the C3 module.

Two other centres admitted students to FM by individual negotiation or with guidance. Two centres said they encouraged all bright and keen mathematics students to take FM. Three centres would allow any student who wished to do so to attend the FM classes; this would not always lead to them taking the exams. One noted that, because FM was timetabled as another A level, some students were prevented from taking it by clashes with other subjects, music being a particular problem.

Whatever the formal entry requirements, six centres said that FM students needed to be keen and to enjoy mathematics. Two added that they also needed to be prepared to work.

No centre indicated that there had been any change in the pattern of take up since the introduction of the new specifications and six said specifically that there had not.

Five centres said that FM was allocated the same time as any other A level. One said that mathematics plus further mathematics only received lesson time equivalent to 1.5 A levels in year 12, three others gave figures in the range of three to five hours per fortnight, and one said that students did one hour per module per week after school.

AEA

Only five centres offered the AEA, although another might consider it in future. Two of these centres did not offer tuition, merely help to students working on practice papers, and one used a bank of material. Another centre had a student working on it himself and yet another had a student considering doing the same. Two centres said they did not know much about AEA.

At the centres providing AEA, the average number of students was six and the maximum 10. These centres thought it was a good way of stretching the most able students, and that it was harder than FM, because it takes topics to a greater depth. They suggested it to the most able students, most of whom were ‘Oxbridge types’ or considering taking mathematics at university.

Staffing and administrative issues

Only three of the centres considered that any difficulties had arisen in staffing as a result of the change in specifications and these were fairly minor concerns related to individual staff who were no longer able to teach their preferred combination of modules. Two centres said that the lower need for specialists in statistics and mechanics made it easier to arrange the staffing, and several indicated that they were using the greater flexibility to broaden staff experience and give them a greater variety of modules.

Eight centres said that they had not encountered any administrative problems as a result of the change to the new specifications. At a ninth a teacher was unhappy that lesson time had been reduced, but this was the result of school policy rather than of the new specifications.

A good point about the new specifications was that it was now possible to complete the first three modules within the first year.

The difficulties were:

- concerns about new textbooks, including the cost, the fact that some were not ready in time and the quality of one series
- having to re-arrange teaching schemes and re-write course notes
- the cost of (unspecified) extra photocopying
- organising resits and ensuring that the centre does not lose money because students fail to turn up to do the resit
- that the Christmas deadline for the C3 numerical methods coursework is too close to the January exam.

Possible gender differences and their implications

The staff interviewed were asked how far they agreed with the theory that boys are motivated more by the usefulness of mathematics and girls by feelings of security. Overall reactions were that five thought there was some truth in the theory, six disagreed with the theory (i.e. thought that there were no significant differences) and four did not have a view, while two objected to the stereotypical nature of the question.

Some additional points were made on various aspects of the issue. For example there was some support for the idea that girls liked to feel secure (three responses), that they had a stronger work ethic (two) and that they worked harder in order to feel secure (one). However, they could also be motivated by considerations of utility (one).

There was also support for the idea that boys value utility (three) and a selection of comments from different people led to the sequence – boys like knowledge to be useful / capable of being applied – boys like mechanics because it's useful – mathematics, physics and design and technology (D&T) are all targeted at boys who want to be engineers. On the other hand, it was pointed out, some boys like mathematics / pure mathematics / algebra for its own sake or for its beauty.

Given this divergence of view on the underpinning theory, it is not surprising that there was little enthusiasm for advice and guidance material based on the theory. Six people disagreed, believing that advice and guidance material should be the same for all, four agreed that differentiated material could possibly be useful and five had no comment. One suggested that ‘to encourage girls to do mathematics we need to promote girls in textbooks and at GCSE level’ and another that ‘it needs to be targeted at year 10 and 11 students’.

Use of guidance and resources

Of the staff interviewed, seven said that they were not aware of the Standards Unit materials and guidance, and six were aware but not using it. Three used the material a little or were trialling it, with one expecting to use it from September 2006. Several expressed support for the general approach or interest in finding out more, but there were no whole-hearted users. Two people mentioned that a lot of preparation time was needed to make use of this material.

Only one centre was using the Further Mathematics Network website. Six staff were not aware of it and six were aware but not using it.

Other resources that staff had used included:

- Edexcel courses about the new specifications
- attending UMIST courses about individual modules (for example M1) for first-time teachers, analysing what examiners are looking for
- sample and mock papers from the board
- other general advice and support from the awarding body; MEI was said to be very helpful and provided a newsletter
- a local mathematics network
- Solomon Press practice papers, as well as their own bank of papers
- attending Standards Unit regional meetings
- "mathematicsnet" and "samlearning" websites

- other unspecified support material from the web (‘but the problems are often not relevant to the syllabus’)
- Phillip Allen resource materials
- use of the interactive whiteboard
- use of Autograph, for example to demonstrate the use of lower and upper bands when integrating a function to find a volume
- use of Derive
- Delphis papers
- internal support from other teachers / ‘each other’.

When asked whether they would like further support and guidance for A level mathematics or further mathematics, staff at seven centres said that no additional help was needed, four of them adding that within the department they were able to support each other. A further four centres felt that they were ‘doing quite well’ but that additional resources were always useful. One ‘hadn’t found software resources’.

Three centres said that they would like more resources for further mathematics and that there was little available for this subject, especially FP2.

Funding and technology issues affected only a minority of centres but were serious where they occurred. One school said that they would like to send people on a relevant three-day course at a university but that their budget did not support this. A college said that they had had considerable help from a staff member at Edexcel, but that his budget for providing support was running out.

Both the further education colleges in the sample had serious weaknesses in the technology available to the mathematics department. One had been criticised by inspectors for not using technology in mathematics lectures, but said that their rooms were still not networked or connected. The otherhad long been in need of a screen for their OHP and had no internet connection in the A level block. ‘It would make such a difference to have just one computer in each classroom as well as an interactive whiteboard. We would then be able to do immediate demonstrations.’

One of the independent schools also said that they needed a better computer system and a data projector.

Dissenting voices

The overall tone of most of the responses was encouraging. Staff generally regarded the new specifications positively and saw improvements in the levels of recruitment, retention and achievement, even though they recognised the pressures being brought to bear on mathematics courses.

Others were determined to see their glass as half empty rather than half full:

> ‘As mathematics becomes more elitist there shouldn’t be a problem. Those wanting to do medicine won’t do it in future, as they can’t guarantee they will achieve an A.’

‘Nowadays we have got weaker students doing mathematics because they are doing four A levels. This means we have students who wouldn’t have done it in the past and are doing four A levels and so have more work to do outside the classroom. Mathematics is still so much harder than their other A levels. The less able used to do SMP but unfortunately we can’t offer that now.’

> ‘Students feel more under pressure as they are now expected to get three good grades by the end of year 12.’

‘I tell my students you learn mathematics from practising it. But that element is missing. It’s a real tragedy. Media is oversubscribed here because they know it’s easier. They are being driven away in droves. We have to offer 'Use of mathematics and statistics'. If we didn’t offer that we would be four groups down. Some of those are people who have left mathematics because it’s too difficult. The drop out after AS mathematics is very high.’