The end of the Further Mathematics Network and the start of the new Further Mathematics Support Programme

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The Further Mathematics Network (FMN) [1] came to an end on 31 July 2009 after 4 years of promoting AS/A level Mathematics and Further Mathematics and providing tuition to students who could not access Further Mathematics in their own schools and colleges. The FMN transformed the level of participation in Further Mathematics. In round numbers, since the FMN started in 2004/5, the number of students taking AS Further Mathematics has trebled to over 13,000 and the number of those taking the full A level Further Mathematics has doubled to over 10,000. These increases are far larger than for any other mainstream subject. Over the same period the percentage of A level Mathematics students also taking A level Further Mathematics has risen from 11% to 15% and the number of state schools and colleges offering Further Mathematics has increased from less than 40% to around 60%.

Tables 1 and 2, below, show how student numbers have increased since 2004.

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Table 1 – AS/A level further mathematics student numbers 2004-2009 (Source: JQA 2009)

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Table 2 – AS/A level mathematics student numbers 2004-2009 (Source: JQA 2009)
Table 1 shows that Further Mathematics numbers increased very strongly over the period that the FMN operated, following a period of several years of very low numbers, of the order of 5,000 (the UK figure for A level FM in 2003 was 5,315).

An important factor in the Further Mathematics increases is that when A level Mathematics and Further Mathematics were re-structured in 2004, it became far easier to timetable Further Mathematics alongside Mathematics and this resulted in more schools and colleges being able to offer it. This helps to account for the increases in Wales and Northern Ireland, but they are significantly lower than those for England, where the FMN operated.

The corresponding figures for AS/A level Mathematics, shown in Table 2, also show very encouraging increases, but the increases are much smaller than those for Further Mathematics.

Following the publication of the 2009 examination results, Professor Dame Julia Higgins FRS, Chair of the Advisory Committee on Mathematics Education (ACME), said:

“It is wonderful news that the numbers studying A Level Mathematics and Further Mathematics continue to rise, year-on-year. More students choosing mathematics beyond 16 benefits the individuals, universities, employers and, ultimately, the nation as a whole. The particularly large increases witnessed in Further Mathematics are testimony to the dedicated work of the Further Mathematics Network. I am delighted that their work will continue in this arena under the Further Mathematics Support Programme.”

On 1 August 2009 the Further Mathematics Network was replaced by the Further Mathematics Support Programme (FMSP). The FMSP continues the work of the Further Mathematics Network and extends it to provide professional development for teachers of Further Mathematics and support for the teaching and learning of level 3 Mathematics within diplomas. Like the FMN, the FMSP is managed by Mathematics in Education and Industry (MEI) and funded by the DCSF. The National Centre for Excellence in Teaching Mathematics (NCETM) is working in partnership with MEI to support the FMSP’s professional development role.

The FMSP is initially funded until April 2011, but it is possible for funding to be extended.

How does the FMSP compare to the FMN?

The FMSP has less government funding that the FMN, and so has significantly fewer staff. However, the success of the FMN in bringing Further Mathematics back into the mainstream in state sector schools and colleges means that we have been able to structure the FMSP to maintain and develop the FMN’s work.

Structure

The FMSP has a small central management team of 6.2 full-time equivalent staff, employed by MEI. The key personnel involved were all part of the FMN’s central team.

Whereas the FMN had 46 ‘Further Mathematics Centres’ across England, managed locally by the equivalent of 46 half-time ‘FMN Centre Managers’, the FMSP has 20 half-time ‘Area Coordinators’ working in small teams across the 9 government regions.

As was the case for the FMN Centre Managers, the FMSP Area Coordinators are employed mainly by universities. The universities of Cambridge, Essex, Kingston, Leeds, Liverpool, Loughborough, Manchester, Nottingham, Plymouth, Royal Holloway, University College London, Warwick and Wolverhampton all employ Area Coordinators, and others are employed by local authorities or schools. All of the Area Coordinators were previously involved in working with the FMN. Many of the former FMN Centre Managers who have not become FMSP Area Coordinators are still involved, supporting the FMSP as Associates, working in cooperation with the FMSP Area Coordinators in their regions. Many act as FMSP tutors and organise local FMSP enrichment events and revision days.

Support for Further Mathematics

The FMN’s key functions were to work to ensure universal access to tuition in AS/A level Further Mathematics and to promote the uptake of AS/A level Mathematics and Further Mathematics.

The FMSP continues the FMN’s work in these areas, but with an even stronger emphasis on helping schools and colleges to teach Further Mathematics themselves. This need is fulfilled by providing CPD and mentoring for teachers to enable more of them to teach Further Mathematics, and supporting schools and colleges to work together in local consortia to teach Further Mathematics. This should enable more schools and colleges to provide Further Mathematics tuition sustainably, without the need for external tutors. The flowchart in Fig 1 shows how the FMSP assesses the need for Further Mathematics tuition support in a school or college.
This academic year the FMSP is meeting all of the tuition commitments carried over from the FMN (approximately 800 students are receiving tuition from around 180 schools and colleges), and it is working with schools and colleges to further widen access for students in the future.

**Professional development for teachers**

In partnership with the NCETM, the FMSP is offering extensive opportunities for teachers to develop their subject knowledge and pedagogical skills to enable them to teach Further Mathematics. These courses were piloted by the FMN, but whilst teachers' professional development was not a specified role for the FMN, it is a key strand of work for the FMSP. As was the case for the FMN, much informal professional development takes place through the FMSP by teachers asking for expert advice, accessing free online resources or attending FMSP revision days or enrichment events.

The following professional development courses in the teaching and learning of Further Mathematics are offered by the FMSP:

- professional development days; these are arranged locally across England by FMSP Area Coordinators;
- a certificated course in ‘Teaching Further Mathematics’ (43 teachers are enrolled on the course, which can lead to credits towards a masters degree); and,
- live online professional development focusing on subject knowledge for teachers and potential teachers of Further Mathematics.

These courses all received positive feedback when offered/piloted by the FMN.

Specialised courses are also being developed to support teachers of mathematics within the level 3 Engineering Diploma.

Professional development, with an emphasis on subject knowledge, as well as pedagogy, is a key way to improve the skills and confidence of Mathematics teachers at pre-university level. This improves students’ access to high-quality tuition and raises the level of mathematical knowledge and understanding of new undergraduates.

**Support for mathematics within level 3 diplomas**

Part of the FMSP’s remit is to support the teaching and learning of level 3 mathematics within diplomas – the only diploma to contain a significant amount of mathematics is the level 3 Engineering Diploma, which has both a compulsory principal learning element, and an Additional Specialist Learning (ASL) unit. The FMSP’s support will help teachers support their students’ mathematical needs effectively. Professional development courses for teachers are currently under development; online teaching and learning resources to support the mathematics within the principal learning unit have already been made available. More online resources are planned for the ASL unit. FMSP support for the level 3 Engineering Diploma involves professional development of teachers and the provision of teaching and learning resources. It does not extend to the direct tuition of students.

**Registered schools and colleges**

Around 2,200 schools and colleges are registered with the FMSP, about 2,000 of which offer A level Mathematics. There are around 2,500 schools and colleges offering A level Mathematics in England.

Registration with the FMSP is free and qualifies schools and colleges for a single password access to extensive online resources to support the teaching and learning of Further Mathematics. Registered schools and colleges receive regular newsletters and are invited to take part in enrichment events, revision days, online revision sessions,
and professional development activities organised through the FMSP and often hosted by universities.

Through the registration process, the FMSP provides support for schools and colleges that teach Further Mathematics themselves. As well as access to resources and invitations to events, the FMSP Area Coordinators also offer expert advice and encourage collaboration between local schools, colleges and universities.

Enrichment

Through its enrichment activities the FMN encouraged Key Stage 4 students (ages 14-16) to go on to take AS/A level Mathematics and Further Mathematics, and for students who are already studying mathematics at AS/A level, the FMN promoted careers and degree courses in mathematics and mathematics-related subjects. It also worked to forge links between university mathematics departments and the mathematics departments in local schools and colleges.

Over 7,500 students attended FMN enrichment events in 2008/9. A typical event for 14-16 year-olds involved three or four interactive talks in groups of about 20 on interesting mathematics topics, a plenary lecture and information on AS/A level Mathematics and Further Mathematics and degree courses and careers involving mathematics. The events were aimed at students who have some aptitude in mathematics and who were at least considering taking it at AS level. They were usually either free, or charged for at cost. The events were often hosted by universities and sometimes include a university tour.

The FMSP is continuing the FMN’s work in supporting mathematical enrichment activities to help increase participation in mathematics post-GCSE, and communication and marketing is a key strand of the FMSP’s work.

As part of its enrichment programme the FMN organised, jointly with the United Kingdom Mathematics Trust (UKMT), the ‘Senior Team Mathematics Challenge’, a national team mathematics competition for 16 - 19 year-olds. Last academic year over 700 schools and colleges took part. The FMSP has taken on the FMN’s role and this academic year over 800 schools and colleges have taken part, involving more than 3,200 students. [2].

Through online tuition the FMN also supported students taking the STEP and AEA examinations. Many schools and colleges are unable to support students taking these examinations and the FMN provided online tuition to help ensure that high quality support is available to all students. This work is not within the remit of the FMSP, but it is continuing through MEI [3].

Revision days

In 2008/9 over 10,000 students attended FMN revision days. The days covered AS/A level Mathematics or Further Mathematics. They were normally focused on a particular AS/A level unit and involved an intensive day going over the entire specification and revising the more difficult points in detail. The days were usually charged for at cost. Teachers from registered schools and colleges could attend the days for free and reported that, as well as being very useful to their students, the days provided excellent professional development for teachers themselves. The days were usually hosted by universities. The FMSP is continuing these revision days in the same format. It is also providing, free of charge, live online revision sessions for FMSP-tutored students and students from schools and colleges registered with the FMSP.

Working with universities

Over 50 universities were involved in hosting FMN events and the FMSP is building on the FMN’s strong relationships with universities.
Now that access to Further Mathematics has been improved, and numbers are rising strongly, increasing numbers of universities are encouraging applicants to take Further Mathematics. The FMSP lists university departments that openly encourage Further Mathematics on its website [4]. This list has grown dramatically over the past four years, and it no longer includes just the leading universities (though some of these are now demanding it). This statement from the University of Derby is typical:

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“Mathematics: Further Mathematics AS/A2 is not a requirement for entry onto our programmes, but if you have the opportunity to take further maths at AS or A level, we strongly recommend it. We find that students who have taken these extra qualifications handle the transition from school or college to university very well. The University is prepared to be more flexible with students who have studied Further Mathematics but not met the standard offer.”

The report of the symposium, ‘Newton’s mechanics: Who Needs It?’ [5], held in Cambridge in 2008, includes the following recommendation:

“Recommendation 4.1
Further Mathematics
Schools and colleges should ensure that AS/A level Further Mathematics tuition is available to their students, and university departments should consider encouraging Further Mathematics in their prospectuses and offers.”

Many university departments comment on the lack of mathematics skills of new undergraduates who have not studied mathematics beyond single A level Mathematics. Studying Further Mathematics improves students’ preparation for mathematics-related degrees courses. It should be a point of honour for university mathematics departments, and many other university departments in mathematics-rich subjects such as engineering, computing, physics and economics, to appear on the list of departments that encourage students to take Further Mathematics.

Current developments

Targeting support in areas of greatest need

At the time when the FMN was set up in 2004/5, little was known about local variations in the provision and uptake of Further Mathematics across England. Over the four years that the FMN was in operation, the FMN centres built up a detailed picture of the provision of Further Mathematics in the schools and colleges within their local areas. In addition to the information gathered by the FMN centres, the FMSP has access to detailed data from the DCSF on the uptake of AS/A level Mathematics and Further Mathematics. These data are now helping the FMSP to target its efforts, to improve Further Mathematics uptake in areas of greatest need.

DCSF data from 2007/8 showed wide differences in local uptake of Further Mathematics. For example, for state-funded schools and colleges in London, in one local authority there were more than forty A levels taken in Mathematics for each A level taken in Further Mathematics, whereas for others the ratio was less than 6:1. There was also wide variation in rural areas, with the A level Mathematics to Further Mathematics ratio varying from up to 20:1 in the areas with the lowest uptake to less than 6:1 in areas with the highest. For the state sector, the average in 2007/8 was 7.8 Mathematics A levels for every Further Mathematics A level (improved from 8.5 in 2006/7).

Targeted FMSP support can help ensure an appropriate level of uptake of Further Mathematics across all areas of England. It is worth noting that in the independent sector the ratio of A level Mathematics to Further Mathematics is less than 5 to 1.

Promoting AS Further Mathematics to students in year 13

AS Further Mathematics is accessible to any student capable of passing A level Mathematics. It is an excellent course to help improve students’ mathematical fluency, as well as introducing them to important topics, such as complex numbers and matrices, that are not included in the single A level Mathematics specification. This means it is an ideal preparation for the transition to a mathematics-related degree.

The FMSP believes that there is scope for large increases in the numbers of students taking AS Further Mathematics and is emphasising to schools, students and universities the possibility of students taking AS Further Mathematics in year 13, alongside their A2 in Mathematics. This option is especially useful for students who did not choose to study AS Further Mathematics in year 12, straight after their GCSEs,
but who plan to go onto take degrees in areas such as engineering, sciences, computing and economics, as well as mathematics itself.

AS Further Mathematics can enable students to take more mechanics or statistics units, depending on the subjects they wish to take at university. Studying extra mechanics units is especially useful for students going on to degree courses in engineering or physics.

**Conclusions**

During its four years of operation the FMN established a successful methodology to support the teaching and learning of pre-university mathematics. Over this period the numbers of students taking AS and A level Further Mathematics showed sustained growth. An increasing number of schools and colleges are teaching Further Mathematics and many more universities are encouraging students to take it.

The challenge for the FMSP is to maintain this momentum, to help bring about long-term, sustainable improvements in the mathematical preparation of young people progressing to degree courses in mathematics and mathematics-related subjects. Support from universities in encouraging students to take Further Mathematics and in supporting the work of the FMSP can help to meet this challenge.

**References**


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