CEM
Centre for Evaluation & Monitoring

Durham University

Evaluation of the Further Mathematics Support Programme 2009-2012

Summary Report: August 2012

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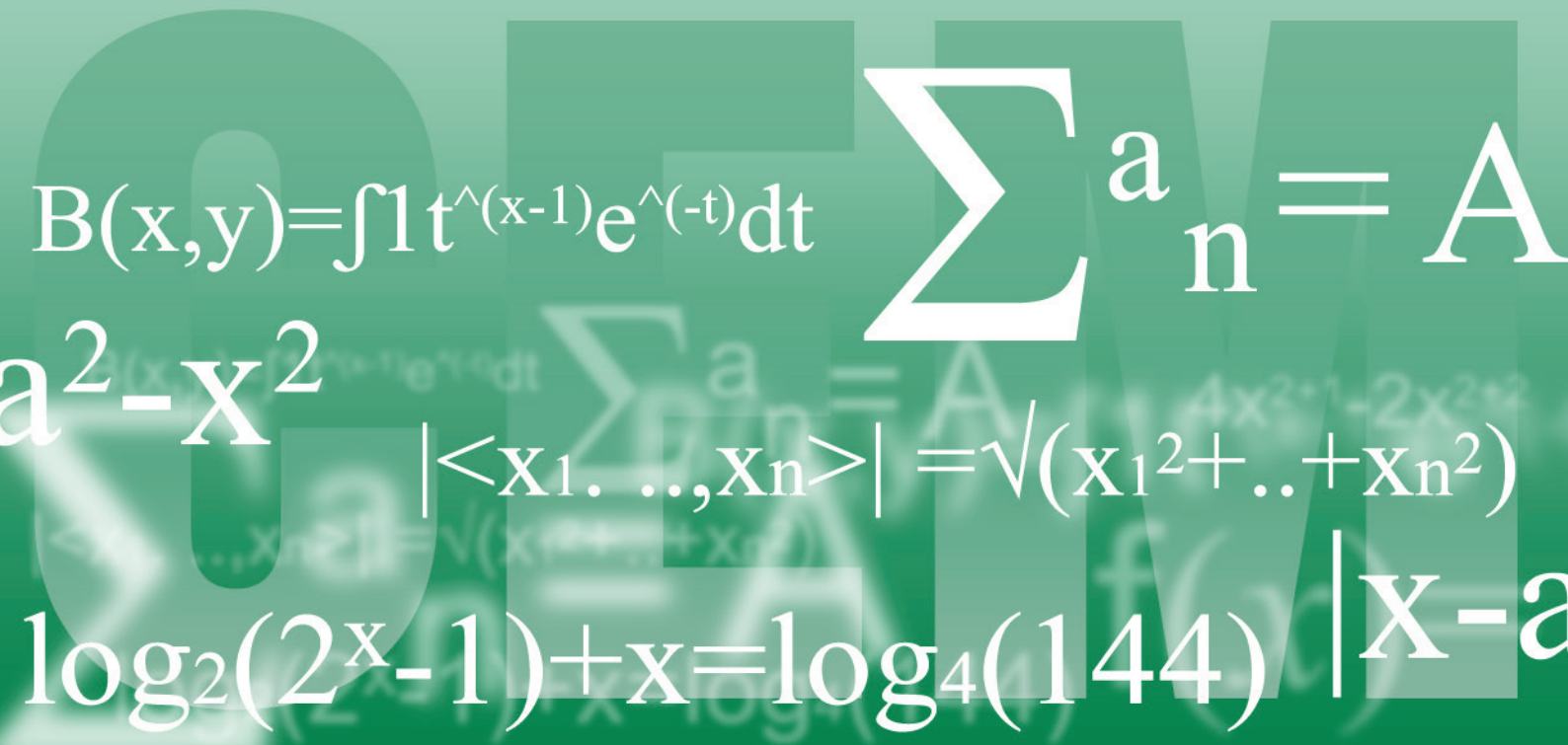


Executive Summary

The Centre for Evaluation and Monitoring (CEM) has been the evaluator of the Further Mathematics Support Programme (FMSP) since its formation in 2009, and of the previous Further Mathematics Network. This report is a summary of the three evaluations, Phase 1, Phase 2 and Phase 3, which have been conducted between August 2009 and August 2012.

The FMSP continues to make considerable progress towards achieving its aims of widening access to Further Mathematics, increasing the number of students who study both AS level and A level Mathematics and Further Mathematics and developing the knowledge, expertise and confidence of teachers to teach Further Mathematics in their own schools and colleges.

To date, the FMSP has achieved all of the Key Performance Indicator success measures agreed with the Department for Education relating to the Phase 3 period. These are referred to throughout the report on Phase 3.

An analysis of entry and achievement data from both the Department for Education and the Joint Council for Qualifications shows that student numbers in both Mathematics and Further Mathematics continue to grow strongly year on year. Further Mathematics has been among the four fastest growing A level subjects throughout the period of the FMSP.

Phase 3 looked in particular at the FMSP's work to continue to extend access to Further Mathematics. The 'priority schools' initiative aims to introduce Further Mathematics into specified target schools. This is working effectively, with a substantial number of priority schools now receiving support as a result of this initiative. Telephone interviews with teachers from some of these schools show that they welcome the support of the FMSP and the positive effect that it is having on the development of mathematics in their establishments.

The 'Access to Further Mathematics' events arranged by the FMSP in March 2012 aimed to provide advice to schools and college on initiating Further Mathematics or enhancing their existing provision. University academics took part in these events to help make the case for Further Mathematics, which was made very convincingly.

The FMSP continues to offer an extensive range of professional development opportunities to teachers. Feedback from teachers who have taken up these opportunities was extremely positive about the effect they have had on their teaching. The range of events and courses, both face-to-face and online, and the feedback from teachers on them, are reviewed in this report.

Two surveys of students who have experienced tuition through the FMSP indicated that they were generally very positive and grateful for the opportunity to study Further Mathematics. Students found both the mode of study and the mathematics studied to have helped them when starting higher education courses. This was reinforced by some subsequent telephone interviews with students.

The revision programmes provided by the FMSP, both face-to-face and online

have been evaluated. The uptake for both has been considerable and the feedback is excellent, indicating a high degree of satisfaction. Over 500 students gave feedback on their use of online revision in 2010/11, with the vast majority saying they felt better prepared for their examinations and would recommend FMSP revision sessions to others.

An extensive programme of enrichment events has been offered each year by the FMSP. These have been well attended with over 3000 students participating in 2010. Teachers reported through telephone interviews that their students enjoyed these events and benefited from them. The teachers thought the events achieved their aim of inspiring the students and stimulating their interest in mathematics. They noted many Key Stage 4 students have indicated they are likely to continue to study mathematics following GCSE as a result of attending an FMSP enrichment event.

The view of the mathematics community on FMSP was sought in Phase 2 of the evaluation. A range of prominent stakeholders in mathematics education in England were invited to give a view on the FMSP. Many responded and all were very positive about the FMSP and what it has achieved in promoting Further Mathematics. All put the view strongly that the FMSP should continue in its work.

This report concludes that the FMSP's work is very effective and it is succeeding in its key aims. Teachers value what it does and want it to continue. Students value the opportunities it offers that might not otherwise be available to them. The FMSP's work is essential if current levels of participation in Further Mathematics are to be sustained and further expanded.

Contents

1 Introduction and background

The Further Mathematics Support Programme (FMSP) was formed in August 2009, following on from the previous Further Mathematics Network (FMN), which was operational between 2004/05 and 2008/09. The Education Evaluation Group at the Centre for Evaluation and Monitoring (CEM) at Durham University conducted three evaluations of the FMN, and continued to evaluate the FMSP. There have been three evaluations, referred to as phases. Phase 1 of the evaluation covered the period from the formation of the FMSP to February 2010. Phase 2 covered the period from March 2010 to March 2011 and Phase 3 from then until May 2012.

In Phase 1 the baseline for assessing the impact of the FMSP on student entries and achievement in Further Mathematics was set in 2008/09. This was the last year in which the former FMN had any direct influence on entries and results, and in subsequent years the FMSP would have opportunity to influence entries and results.

The number of entries at both AS and A level for Further Mathematics has been monitored and updated in subsequent reports. The impact of the FMSP in terms of entries and achievement up to August 2012, including the number of establishments offering Further Mathematics, is reviewed in Section 2 of this summary report.

The principal aspect of Phase 1 was to assess the level of awareness in schools and colleges of the newly formed FMSP and the services it offered, and the take up of those services. A questionnaire based survey was conducted with 500 state schools and colleges, stratified regionally but otherwise selected at random, who had offered at least AS Mathematics in 2007/08. Respondents were also invited to take part in a telephone interview. A response rate of about 25% was achieved. This survey was repeated in Phase 2 with a different 500 schools and colleges, with a similar response rate. Over one hundred telephone interviews were conducted soliciting teachers' views on the development of post-16 advanced mathematics in their establishment and their level of involvement with the FMSP and the support it offers[1] . For students, support included tuition in Further Mathematics, revision in preparation for examinations and also enrichment events; for teachers, support included advice in course management, opportunities for professional development and the use of the FMSP's online resources. These aspects of the support available from the FMSP are enlarged upon in Sections 4 and 5 of this summary report.

The surveys and interviews covered both A level and AS level Mathematics and Further Mathematics and also the mathematics of the level 3 Diploma in

1 All interviews conducted for the evaluations have followed the Durham University ethics code of practice.

Engineering, which was part of the brief of the FMSP to support at the time. The surveys indicated wide awareness of the FMSP and its role in the development of post-16 mathematics but little awareness, or interest, in the level 3 Diploma[2] . The actual, or intended, use of the FMSP's services varied widely between different schools and colleges. The telephone interviews indicated considerable support for the FMSP, with many teachers saying that Further Mathematics would not have been initiated and would not have developed in their establishment without the support of the FMSP. It is recognised that although a response rate of 25% from one thousand schools was a good return, there is no way of knowing how representative this was of all teachers in the schools and colleges that were approached to take part; this is a limitation of any evaluation involving surveys and interviews.

The actions taken by the FMSP to help initiate and develop Further Mathematics in establishments where it is not currently offered, or is in the early stages of development, are covered in Section 3.

The views of students who have received tuition through the FMSP are included in Section 4.

The views of stakeholders in the wider mathematical community are included in Section 6.

2 Support for the mathematics of the level 3 Diploma in Engineering was dropped from the brief of the FMSP before Phase 3 of the evaluation.

2 Impact of the FMSP on the uptake of A level and AS level Further Mathematics and Mathematics

2.1 Student entries

The figures shown in Table 1 are those of the Joint Council for Qualifications. These are published annually, each August, following the summer examinations and thus the 2012 figures are now available. The JCQ figures are less authoritative than those released later by the Department for Education (DfE), but are indicative of the year-on-year growth.

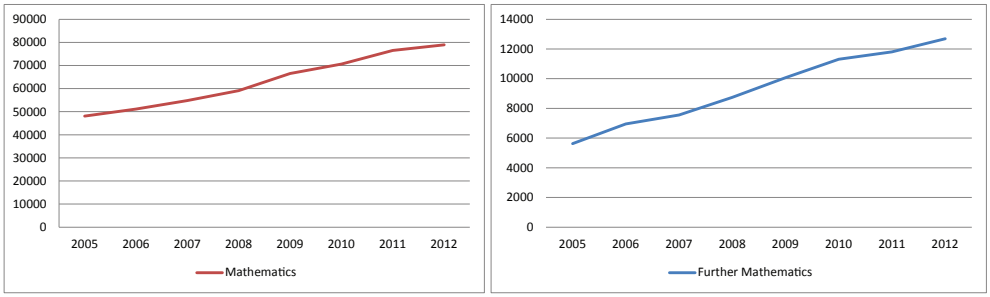
Table 1: Number of candidates entering A level and AS level Mathematics and Further Mathematics from 2005 to 2012

		2005	2009	2005-2009 percent change	2012	2005-2012 percent change	2009-2012 percent change
Further Mathematics	A level	5627	10073	79%	12688	125%	26%
	AS level	4809	12710	164%	20370	324%	60%
Mathematics	A level	48058	66552	38%	78951	64%	19%
	AS level	62633	95408	52%	139585	123%	46%

Source JCQ

The figures for both Mathematics and Further Mathematics are shown as the FMSP has the support of A level Mathematics as part of its brief. It can be seen that candidate entries for both these qualification have increased substantially, both during the period of the FMN and that of the FMSP. It seems likely that the government target of 80000 entries in A level Mathematics in 2014 will be exceeded a year early. The growth in entries is also shown graphically in Figure 1.

Figure 1: Growth in A level Mathematics compared to Further Mathematics



The proportion of A level Mathematics candidates who also take A level Further Mathematics

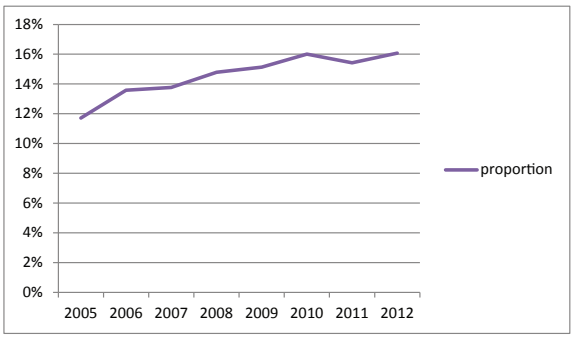


Figure 1 also shows that the proportion of candidates who enter for both the full A levels in Mathematics and Further Mathematics has been rising steadily during this period from 11.7% in 2005 to 16.1% in 2012. A similar graph for AS level is not appropriate as a number of students take the full A level in Mathematics together with the AS in Further Mathematics, and some students will not pursue Mathematics beyond the AS level; the precise figures are not known.

The figures in Tables 2 and 3 are from the Department for Education (DfE) official statistical release for 2010/11 and apply to candidates aged 16, 17 and 18. They indicate that the JCQ figures are a good representation of the number of sixth form age students who take Mathematics and Further Mathematics.

Table 2: GCE A level and AS level Further Mathematics entries 2008/09 to 2010/11

	Percentage of students achieving grade								
A level	**A***	**A**	**B**	**C**	**D**	**E**	**Pass rate**	**Total entries**	**Annual percentage increase**
2010/11	27.5	31.2	21.0	10.3	5.7	3.0	98.7%	11408	5.5%
2009/10	29.3	30.1	20.2	11.4	5.4	2.8	99.3%	10813	14.5%
2008/09	-	59.1	20.2	11.0	5.4	3.2	99.0%	9443	11.8%
AS level									
2010/11		40.7	17.8	13.9	10.1	7.5	90.0%	12427	31.9%
2009/10		41.9	19.2	13.8	10.6	6.9	92.5%	9421	12.2%
2008/09		41.0	19.7	14.9	10.4	7.0	93.1%	8399	48.5%

Source DfE

The AS figures should be treated with some caution as not all students who continue on to the full A level will certificate for the AS level at the end of year

12 and some may not certificate at all. Some students may only study Further Mathematics to AS level, and that may be in Year 12 or Year 13, or over both years. It should also be noted that in terms of gender, about twice as many male students take Further Mathematics at both levels as female students, a trend which has continued over several years. The FMSP should continue to attempt to address this issue of gender imbalance. In Mathematics the gender ratio of males to females is approximately 3:2.

Table 3: GCE A level and AS level Mathematics entries 2008/09 to 2010/11

	Percentage of student entries achieving grade								
A level	**A***	**A**	**B**	**C**	**D**	**E**	**Pass rate**	**Total entries**	**Annual percentage increase**
2010/11	18.2	26.9	21.9	15.6	10.4	5.6	98.6%	75547	8.2%
2009/10	17.0	27.9	22.0	15.5	10.1	6.0	98.5%	69803	8.2%
2008/09	-	45.4	21.7	15.3	10.1	5.8	98.3%	64517	12.0%
AS level									
2010/11		24.3	15.8	15.1	14.0	12.1	81.3%	104586	31.6%
2009/10		23.5	16.5	15.5	14.2	12.3	81.9%	79458	7.8%
2008/09		23.3	15.3	15.1	14.9	12.9	81.5%	73728	11.4%

Source DfE

The figures in Tables 2 and 3 support those shown in Table 1 that the number of student entries in both Mathematics and Further Mathematics has grown substantially during the period of operation of firstly the FMN and, since 2009, the FMSP. Although the growth in numbers cannot be attributed directly to these organisations, the evidence from our evaluations suggests the FMN and FMSP have been very influential in bringing them about.

Further analysis of the DfE data shows that Further Mathematics has been amongst the five fastest growing subjects in terms of year on year increase in entries, for each of 2009, 2010 and 2011. This is shown in Table 4.

Table 4: Top five fastest growing A level subjects.

Position	2009	2010	2011
1st	Economics	Other social studies	Other modern languages
2nd	Mathematics	Economics	Mathematics
3rd	Further Mathematics	Further Mathematics	Chemistry
4th	Other modern languages	Business Studies	Further Mathematics
5th	Government and Politics	Biological Sciences	Government and Politics

In the JCQ trends document, August 2012, Further Mathematics is shown as the fastest growing subject at both AS level and A level. It is likely that the work of the FMSP in promoting Mathematics to Key Stage 4 students is contributing to the increases in entries.

2.2 Establishments offering Further Mathematics

The number of state sector establishments offering AS level and A level Further Mathematics has increased since the baseline year of 2008/09. In 2010/11, there were 1264 establishments offering the full A level, an increase of 113 or about 10% on 2008/09, and 1383 establishments offering the AS level, an increase of 215 or about 18%. These increases in the number of establishments offering Further Mathematics reflect the growth in candidate entries, and are likely to be due to the influence of the FMSP in initiating Further Mathematics in state schools and colleges where it was not previously offered.

Figure 2

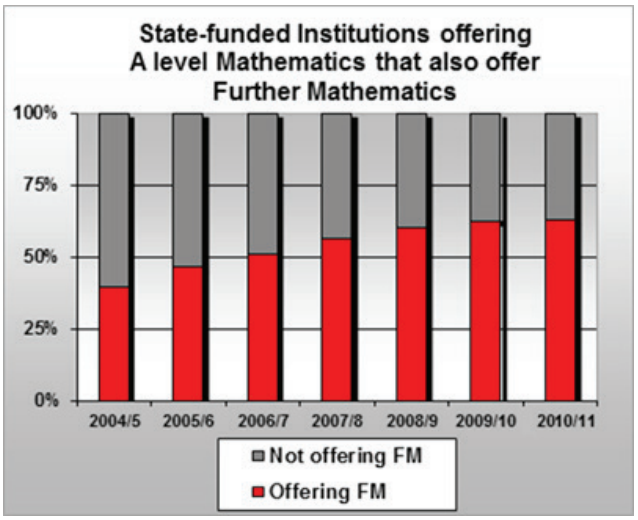


Figure 2 shows the proportion of state-funded establishments that offer A level Mathematics that also offer Further Mathematics. This proportion has risen from below 40% to well over 60% over the period of the FMN and FMSP. Recent increases in this percentage have not been as large as earlier but this is probably due to a large number of establishments setting up new post-16 provision. Such establishments tend to offer Mathematics straightaway, but do not offer Further Mathematics until their post-16 provision has become more established.

Another aspect of the growth in student numbers and establishments is the student cohort size in each establishment. Table 5 shows how the cohort size of students entering for A level Further Mathematics at state-funded establishments has changed over the period 2005 to 2011. The modal size entry has remained at 1, with little change in the frequency, although the number of establishments with larger cohorts has been steadily increasing. This suggests that the work of the FMSP is helping schools and colleges that already offer Further Mathematics to expand their provision, and enabling other schools and colleges to start offering Further Mathematics for the first time. It is important that support from the FMSP should continue to help ensure that schools and colleges who have recently started to offer Further Mathematics can grow their provision to sustainable levels.

Table 5: Change in student cohort entry sizes 2005 to 2011

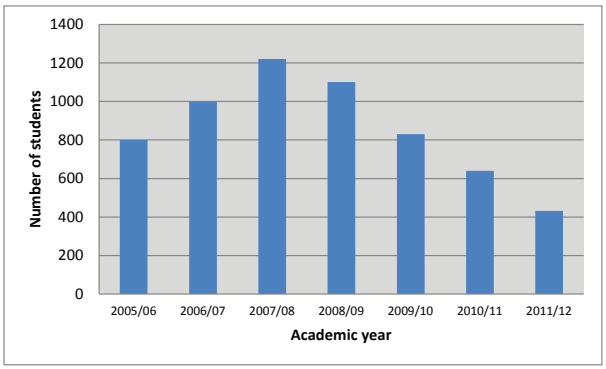
	Number of establishments with cohort sizes of:	Percentage of establishments with cohort sizes of:		
	1 entry	more than 25 entries	6 or more entries	11 or more entries
2011	255	54	40.1%	16.6%
2010	243	48	40.6%	16.7%
2009	279	39	34.8%	13.8%
2008	304	29	34.5%	12.8%
2007	255	23	31.l1%	10.9%
2006	257	18	30.6%	10.5%
2005	250	12	26.2%	8.7%

Source DfE

2.3 Sustainability of Further Mathematics provision

The FMN was initially set up to provide access to Further Mathematics to students whose school or college did not offer it. The FMSP has continued to provide tuition through its tutor network, either for some modules or for a whole course. Figure 3 shows the number of students who received at least some tuition through the FMN and FMSP from 2005/06 to 2011/12. This number has dropped over the last three years whilst the number of students studying Further Mathematics has risen, suggesting more schools and colleges are able to teach their own students.

Figure 3: Number of students receiving some tuition in Further Mathematics through the FMSP 2005/06 to 2011/12.



In Phase 2 of the evaluation the capability of schools and colleges to take the teaching of Further Mathematics 'back in house' or to form a consortium arrangement with other establishments was looked at in detail (see Section 3). A conclusion was that although it was encouraging to see establishments taking over the teaching of their own students, such arrangements were often fragile and their sustainability far from assured, and so they may fall back to a position where they need the FMSP for support with tuition.

Schools and colleges that are registered with the FMSP are asked to declare the status of their Further Mathematics provision in one of five categories, as shown in Table 6[3] .

3 The wording used in Table 6 is abbreviated from that which appears on the registration form. Categories 1 and 2 are combined in Table 6 as the establishment teaches all the Further Mathematics itself.

Table 6

1	All teaching is performed 'in house; there is no reliance on support from the FMSP
2	All teaching is performed in house; establishment receives CPD from the FMSP
3	Some of the tuition is provided by the FMSP
4	All of the tuition is provided by the FMSP
5	Further Mathematics is not offered.

Each year the FMSP reviews the status of the schools and colleges that are registered in order to monitor the numbers that have changed status. Table 7 shows how the status of the 1701 establishments registered with the FMSP in both 2010/11 and 2011/12 changed between the two years. This pattern of changes is similar to that of previous years.

Table 7

		2010-11 FM status				
		1/2	3	4	5	total
2011-12	1/2	1323	25	12	42	1402
FM status	3	13	20	6	5	44
	4	6	4	31	12	53
	5	23	3	4	172	202
	total	1365	52	53	231	1701

Key	number of establishments
	2010-11 to 2011-12
FM provision improved	102
FM provision stayed the same	1546
FM provision reduced	53
Total esatblsihments	1701

In Table 7, it is seen that the vast majority of registered schools and colleges did not change their status. It is notable that 79 establishments in total moved out of categories 3, 4 and 5 into category 1/2 which represent excellent progress in their provision, but the FMSP still has a role in supporting them through offering professional development opportunities to their teachers. Also, if student numbers are small, or a key teacher moves on, some of these may fall back into a lower category. The 97 establishments currently in categories 3 and 4 are dependent on the FMSP for tuition of their students, and it seems likely that at least some of them will remain so in the foreseeable future. It is also notable that 53 establishments in total moved to a lower category, so if they are to continue offering Further Mathematics the FMSP would appear to have a vital role in supporting them.

3 Access to Further Mathematics

3.1 'Back in house' tuition and consortia arrangements

An important aspect of the work of the FMSP is to support schools and colleges that are using tuition from FMSP tutors to take the teaching 'back in house' or to form a consortium with other establishments in order to have viable size teaching groups. Much of this work is carried out by the FMSP's team of Area Coordinators (ACs) who work in the nine government regions of England. In Phase 2, the ACs were asked to identify establishments who had either recently moved to one of these positions or were considering doing so. From the 115 establishments identified the evaluator selected a representative sample of 20 in terms of location and type and invited the AC's teacher contact to take part in a telephone interview. All accepted and in depth interviews on the provision of Further Mathematics in their school or college and its intended development took place. It transpired through the interviews that each of these establishments was different in the way it was trying to offer Further Mathematics and the issues they were facing. However, some points common to most could be drawn out; these were

- The highly supportive role of the FMSP AC both in initiating Further Mathematics and in its continuing development.
- The provision of Further Mathematics was in response to student demand.
- Teachers themselves wanted to teach some Further Mathematics modules.
- Further Mathematics was generally run on less timetable time than a standard A level subject, and was often not in a curriculum option block. (Teaching Further Mathematics on a reduced timetable is not ideal as it makes it harder for all but the very mathematically-able to benefit from the provision.)
- Timetabling constraints meant some students couldn't fit into school provision and studied elsewhere, either through a consortium and/or FMSP providing the tuition face-to-face or via online tuition.
- There had been an explicit drive in the establishment to raise the profile of mathematics.
- Senior managers recognised that offering Further Mathematics encouraged either current students to continue into the school's sixth form, or encouraged students to apply from elsewhere.
- Sustainability is dependent on student numbers and was not certain.
- Professional development needs varied widely.

- The advice and services offered by the FMSP were valued and teachers wanted them to continue.

From these, three factors emerged as key to the sustainability and development of Further Mathematics, and they need to be in place simultaneously.

1. There must be students in Year 11, and possibly Year 12, who are interested in studying Further Mathematics and want to do so in their current school. There must be a sufficient number of such students to form a viable teaching group.
2. There must be at least one teacher who is enthusiastic, capable and willing to support Further Mathematics provision, through being involved in the teaching and/or more general pastoral advice and support to students.
3. The senior management team at the establishment must support the development of Further Mathematics.

All the teachers interviewed indicated that the FMSP has a vital role to play in bringing these factors together and supporting the subsequent development of the Further Mathematics provision in their establishments.

3.2 The 'Access to Further Mathematics' events

During March 2011 the FMSP held an event called 'Access to Further Mathematics' in four English universities located in London, Manchester, Warwick, and York. These events aimed to encourage the introduction of Further Mathematics in schools and colleges that do not currently offer it and to help improve and develop provision in those that do. These events were targeted at particular invited establishments and not publicised. Delegates included school senior managers as well as teachers of mathematics and there were about 20 delegates at each location. The number of delegates was kept small to encourage interaction and discussion. This event was repeated in the same four locations in March 2012. The evaluator attended the event in York as an observer.

The evaluator found the event to be very comprehensive in making the case for Further Mathematics. In particular, university academics took part in the event to illustrate the benefits of studying Further Mathematics to students contemplating STEM subjects in higher education. This view was ratified by a current physics undergraduate who had studied Further Mathematics through the FMSP. This, together with input from FMSP officers and local ACs, gave the delegates a lot of information. However, the delegates also had plenty of opportunity to try out resources, discuss questions and discuss any issues that arose. A full account of the event is available in the Phase 3 report.

Feedback from the exit evaluation forms from the 2011 events was positive, suggesting that the events were successful. Feedback forms were received from 87 out of the 110 delegates. The delegates were asked to rate six aspects of the event and they all found all six to be at least good, with many finding them excellent. In particular, the usefulness of the events was rated very highly, and about 60% of the delegates said they were more likely to offer Further Mathematics as a result of attending.

The success of the 2011 and 2012 events indicates that the events should be repeated in 2013, but informed by an analysis of the 2012 feedback forms and any comments about the programme and its coverage that have been made by delegates. The FMSP should also follow up delegates who attended these events to assess the progress made in their establishments in the provision of Further Mathematics.

3.3 The priority schools initiative

The priority schools initiative was investigated in Phase 3 of the evaluation. This is an initiative set up between the FMSP and the DfE, in which 204 schools and colleges across England were identified as having students from a deprived background and where Further Mathematics is either not currently offered, or has only very recently started to be offered. The FMSP Area Coordinators (ACs) were given the task of making contact with these schools and colleges and establishing a dialogue on how the FMSP could help support the introduction of Further Mathematics. Telephone interviews were conducted with all 20 of the ACs on the extent of their success in establishing a dialogue. They were generally more successful if they had a named contact, but there was no response from many schools and colleges despite repeated efforts by the ACs. However, in some of the schools and colleges allocated to them, the AC knew that the FMSP was already supporting the introduction and development of Further Mathematics and queried the priority school status. The ACs reported that many of the schools and colleges were in a similar position to those moving to take the teaching of Further Mathematics 'back in house' (Section 3.1), in that there is a critical balance between attracting enough students who wish to study Further Mathematics, the availability of staff who have both the expertise and time to deliver at least some of the course and support the students, and the support of the establishment's senior management team.

From the priority schools, the FMSP identified 24 establishments where there had been a positive response and invited the evaluator to make contact with a named teacher with a view to participating in a telephone interview to discuss their progress and the support they needed from the FMSP. All of these 24 teachers were contacted, resulting in 15 interviews. These establishments differed in their needs, due largely to the varying expertise and availability of staff to teach some Further Mathematics, but all were looking for advice and guidance on course management and use of resources, with some asking about professional development opportunities. In some schools the FMSP was already providing some tuition. Although most schools and colleges had small numbers of students, usually fewer than five, teachers hoped that numbers would increase, with many pointing to

growing interest amongst Year 11 students in taking Further Mathematics.

Some of these teachers had been to an Access to Further Mathematics event (Section 3.2), which they said had increased their confidence to introduce Further Mathematics, as well as giving them information with which to convince students and senior management of its importance. Most of the 15 teachers interviewed found the regular contact with the AC to discuss progress and any issues arising reassuring, as was knowing help was available if it was needed. Many appreciated the personal visits that their AC had made to their school, which for some included the AC providing some teaching, or talking to Key Stage 4 students about the importance of mathematics and giving them some challenging mathematics problems to work on.

The FMSP has kept a detailed register of the progress it is making with priority schools. Information from the register shows that, as of May 2012, all of the 204 priority schools and colleges had been contacted by the FMSP and 92 had replied. Of those that have replied, 65 have had a meeting with a representative of the FMSP to discuss and set up support. Of these, 36 are receiving a substantial package of support from the FMSP that will involve some or all of professional development, promotion of mathematics in their establishment and general advice and guidance. The remainder are receiving general support with their provision of Further Mathematics. It is expected that the target of 40 priority schools and colleges offering Further Mathematics in 2012/13 will be met.

4 Student support

4.1 Students who receive tuition through the FMSP

In both Phases 2 and 3 of the evaluation the data from an end of course survey conducted by the FMSP of students who had received through the FMSP were made available to the evaluator. Students received their tuition through face-to-face sessions with their tutor, or through live online sessions or through both. Table 8 shows data from students who responded to the survey.

Table 8: How FMSP students received tuition in 2010/11.

	Face-to-Face	Live Online Tuition	Both	Total
2009/10	102	25	23	150
2010/11	16	19	9	44

Source FMSP

It can be seen there was a poorer response from the students in 2010/11, at about 10% of the students who received tuition. The online questionnaire was more detailed in 2010/11, which may have deterred students from responding. The FMSP should address the issue of how to regain a large sample. Nonetheless, the feedback from both years is very positive with well over 80% of the students indicating the tuition and support they received from their tutor and the resources made available to them as either good or excellent. Students were also invited to make any comment about their experience and many did so, with most of these reflecting their positive ratings in the survey, and many expressing gratitude for both the opportunity to study Further Mathematics and the support they had received. There were some criticisms of particular tutors or courses, which the FMSP should follow up, but overall the responses were overwhelmingly positive.

Students were asked through the survey whether they were willing to take part in a telephone interview in which their views and experiences could be explored further. Although many indicated such willingness and 20 students from both years were contacted via e-mail, there were only five responses in 2010 and three in 2011. However the contrasting circumstances of these eight students brought to light in the interviews illustrates the flexibility of the FMSP in meeting students' needs.

The students interviewed are grateful for the opportunity to have taken Further Mathematics that the FMSP offered them and are generally pleased with the support they received from their tutors although some criticisms were made. The students believe that taking Further Mathematics was influential in securing their progress to higher education. Some highlighted that the topics they had met during their Further Mathematics course has helped them in the first year of their degree courses, which reinforces what was said in the Access to Further Mathematics event

(Section 3.2) about the benefits of studying Further Mathematics. Others noted that the mode of study had been a good preparation for university, whilst another noted how it had enhanced her interest in mathematics. All would recommend studying Further Mathematics through the FMSP to other students, although some noted the commitment needed for success.

4.2 Revision

The FMSP puts on a range of revision events for students preparing for examinations at both AS level and A level in Mathematics and Further Mathematics, organised locally by the Area Coordinators. Feedback is collected using standard exit evaluation forms, which is then summarised and kept by the FMSP for its central records, as well as being used by the AC in informing the organisation and content of future revision events. In Phase 2 the evaluator assessed a sample of twelve summaries; student attendance varied from 6 to 33, although numbers are bound to vary with the course module being revised. Students were asked to rate the event on its content and its delivery, the materials provided, the suitability of the venue and the catering arrangements. The feedback summaries generally indicated that the students rated these five aspects of the event as at least good, with some finding them excellent and students were generally very satisfied with the revision event as a whole. They felt the event attended had helped them to prepare well for their examination and they would recommend such an event to other students. Teachers can also attend these revision events and, in the feedback forms seen, they too gave positive feedback, generally giving higher ratings than the students.

The FMSP has also been developing online revision sessions using virtual classroom software. These sessions are free of charge to students and teachers from schools and colleges registered with the FMSP; they cover a comprehensive range of the Further Mathematics modules offered by the four examination boards in England. A conservative estimate is that each year there are over 7000 attendances at live sessions and over 7000 viewings of recordings of sessions, but it is difficult to obtain exact figures. As part of Phase 3 of the evaluation the feedback from students who had made use of live sessions during 2010/11 was analysed. This feedback is completed online, using a form similar to that used for the face-to-face events. A total of 564 responses were analysed. The analysis indicated that students are generally very pleased with the content and quality of delivery of the sessions and, although there were a few problems, with the computing delivery platform as well. Over 90% of the students felt better prepared for their examinations as a result of attending a session, and over 90% would recommend such a session to others.

4.3 Tutor Training

Students who receive tuition through the FMSP receive their tuition through tutors who work in association with the Area Coordinators. Tuition may be given face-to-face, in groups or online using virtual classroom software.

In each of 2010 and 2011 the FMSP organised two training events for tutors, one in London and one in Manchester. These events provided an introduction to the role for new tutors and a refresher and update for more experienced tutors. The events aimed to give tutors an opportunity to be updated on FMSP developments and to discuss experiences, ideas and issues, both with each other and with the FMSP officers and ACs present. In particular, tutors were brought up to date on providing support to students through online facilities. Phase 3 of the evaluation focussed on the 2011 events and included observation of the event in Manchester, analysis of the feedback forms from both events and some subsequent telephone interviews with a sample of delegates from both events. Observation of the event in Manchester showed that the aims of the event were achieved.

The events were attended by 32 tutors in total, including 10 new tutors. In the exit feedback forms delegates were asked to rate various aspects of the event, including venue, administration, content and delivery of information during the day. Analysis of the forms showed that tutors who had attended were very positive about the events, rating all aspects as at least good, with many finding them excellent. Delegates were also asked what they had found most useful about the event, with the most frequent response being the opportunity to meet with the FMSP officers and to share their experiences and ideas with them and other delegates. The update on the activities of the FMSP and on its resources on the *Integral*[4] website and discussion on the role of being a tutor were also valued.

These views were reinforced through the nine telephone interviews that were conducted. Most tutors had attended the event so that they could feel more part of the FMSP organisation, with some saying they could feel rather isolated in their role. The tutors reinforced that they valued the opportunity to meet with the FMSP officers and share their enthusiasm, and to share experiences and ideas with each other. The interviews indicated that the main concern of tutors is the management of teaching and learning for students on limited time and contact, and a wish for appraisal of their own performance as tutors. Some tutors would have liked a separate event on use of the integral resources. These events were clearly valued by those who attended and the FMSP should continue to offer them, noting points raised in the feedback and considering how to increase the number of delegates.

4.4 Enrichment

4.4.1 Enrichment events for Key Stage 4 students

The FMSP has organised enrichment events for students in Years 10 and 11 (Key Stage 4) for several years. These events are often held on university premises, and visiting a university is a novel and worthwhile experience in itself for most of these students. The aim of these events is to inspire students and to stimulate an interest

4 *Integral* is the name given to website that hosts the FMSP's online resources for mathematics

in mathematics through seeing new perspectives and applications of mathematics and being given challenging problems that they wouldn't normally meet in school. Some events also have a careers aspect and all events aim to encourage students to study mathematics post-16.

During 2010, 30 such events were held across England, with attendance of over a hundred students at about half of them. Analysis of the exit feedback forms indicated that the teachers and pupils had found the events to be at least good, and many aspects of them to be excellent. They would recommend such events to others.

The evaluator attended one of the 31 events planned for 2011/12. The titles and the nature of all these events varies considerably, but even at the one event visited there was a variety of presenters with differing perspectives on mathematics and a range of activities for the students. In the two sessions visited, students were willingly engaged in the activities, and were enjoying themselves whilst being given mathematics-related ideas to think about afterwards. The plenary session on mathematics in sport certainly enthused the 140 students present.

Telephone interviews were conducted with nine teachers who had taken students to some of the 2011/12 events, and again the feedback was generally very positive with all finding it a worthwhile experience for their students that had stimulated their interest in mathematics. There was some criticism including questioning the relevance of the mathematics to the A level curriculum, too little mathematics, the challenges were too easy or too hard and careers talks were not appropriately geared to 14 and 15 year-old students. However, all teachers interviewed wanted to bring students to more enrichment events and to broaden the range of students and not limit such events to gifted and talented students and those from top sets, believing more students could benefit from the experience.

4.4.2 The Senior Team Mathematics Challenge

The Senior Team Mathematics Challenge is an annual competition for teams of four students from a school or college. It is organised by the FMSP in conjunction with the UK Mathematics Trust. In the competition, students work as a team of four to solve a series of challenging and novel problems in a limited time period. Examples of the problems are available on the FMSP website, which can be used by teachers to help prepare their students for the competition.

In Phase 2 the evaluator attended one of the 50 or so regional heats held across England and was able to discuss with some of the teachers present why they took part. Most said their students just enjoyed the experience, and found the challenges stimulating. Teachers liked the opportunity to meet teachers from other schools, as well as gaining ideas for resources they could share with colleagues at school.

Exit feedback forms are collected from teachers by the UKMT organiser at the completion of each heat, covering the administration of the event and the appropriateness of the problems. The evaluator had access to a sample of these forms, which showed that in general teachers were very satisfied with the

organisation of their event and felt that the level of mathematics required to solve the problems was about right. They would all recommend the event to other teachers.

In October 2011, the FMSP organised training events aimed at encouraging schools and colleges who had not previously taken part in the competition to do so. These events were seen as offering an aspect of enrichment to students who attended. Evaluation of these events was included in Phase 3. As this was a new FMSP initiative, notification of these events was not possible until a month or so before the events took place and not all the planned events across the country took place because of low uptake. However the feedback through telephone interviews from the organisers of those that did (mostly Area Coordinators), was positive. Students had been engaged in the activities, enjoyed having a practice go and were keen to take part in the actual competition. They agreed the events were certainly worth repeating in 2012, but with greater prior notice so that students and teachers can plan participation.

4.5 Resources for teaching and learning mathematics on the *Integral* website

Over the last decade Mathematics in Education and Industry, which manages the FMSP, has created an extensive online learning environment of mathematics resources. The majority of the materials are aligned directly to each of the A level specifications for Mathematics and Further Mathematics of the English awarding bodies. Each A level module contains a number of sections, with each section containing an introduction, notes and examples, the highlighting of crucial points, and a multiple choice section test from which students get immediate feedback. Additional exercises with solutions are also available. There are also active learning and other resources and links to external websites. There are also forums, a calendar and messaging facilities within the site. Tens of thousands of individual resources are available on the site.

Any school/college who registers with the FMSP, and who updates their contact details annually, receives a free teacher account to access A level Further Mathematics materials (this means all A level modules excluding Core 1-4, which are A level Mathematics modules) within *Integral*. This enables them to access a substantial amount of material. Students who receive tuition through the FMSP, along with their tutors, have individual access to the materials on the site for the modules they are studying through the FMSP. They also get access, in the period leading up to examinations, to an area of the site containing specific revision materials. FMSP tutors also have access to a separate area of the site where additional materials appropriate for their role can be found. A dedicated forum for tutors is included in this area.

5 Teacher support

Teachers can gain access to the resources on the *Integral* website, as explained in Section 4.5. Attendance at enrichment and revision events for students, whether face-to-face or online, gives teachers opportunities for professional development. The FMSP Area Coordinators also facilitate events at which teachers of advanced mathematics can meet and form networks. However, the FMSP also puts on many events and courses, both face-to-face and online, aimed specifically at supporting teachers through opportunities for continuing professional development (CPD). Face-to-face courses are organised regionally by the Area Coordinators and publicised on the FMSP website and through flyers and e-mails to schools and colleges in each region. The awareness survey (Section 1) indicated a wide variation in the perceived need for professional development but that most teachers recognise the value of refresher courses for experienced teachers and also the need to develop the knowledge, expertise and confidence of new teachers so that they can teach some Further Mathematics modules. Professional development was a major aspect of both Phase 2 and Phase 3 of the evaluation.

Take up of professional development opportunities is measured in teacher days (one teacher attending a one day (or equivalent) course). During 2010/11, data from the FMSP shows that 700 teacher days of CPD were provided via regional face-to-face events, 201 teacher days were provided via live online courses and 204 teacher days of CPD were provided through the FMSP's Teaching Further Mathematics course. In 2011/12 the FMSP has provided or has planned at least the same quantity of CPD. In addition, 59 teachers took FMSP's Teaching Advanced Mathematics course and 43 teachers took the Teaching Further Mathematics course in 2011/12. (see Section 5.3 below).

5.1 Face-to-face events

The evaluator observed a full day event, which was one of two events on a particular Further Mathematics module. Topics from the module were covered with the local Area Coordinator and the FMSP CPD leader acting as tutors. The tutors discussed how the topics might be introduced to students and gave suggestions for developing their understanding. The tutors also showed typical examination questions that students ultimately should be able to answer. This was an intensive day of study and activity for the delegates, but all present were willingly engaged; they left the event with a considerable number of ideas and resources to use with their students. The feedback from the delegates obtained through exit evaluation forms was very positive. They had found the most useful aspects of the day were having time to discuss methods, problems and use of the resources, and time to share ideas and actually do some mathematics.

Feedback forms are collected at the end of all professional development events, which in the first instance inform the AC and the tutors about the planning of subsequent events. All the forms are summarised and the results monitored by the FMSP and retained in a central record. As part of Phase 2 the evaluator assessed a sample of these summaries. Attendance at events varied quite considerably but was typically about 20 delegates. Teachers were asked to rate several aspects of the events; most found the content and delivery of the mathematics topics to be at least good, if not excellent, with any poor ratings relating to venue and catering matters. Asked what was the most useful aspect the day, most teachers mentioned being enthused by the presenters, gaining ideas for teaching, the resources made available and information on web based resources. Teachers new to a module valued receiving an overview of the module's content and help in developing their understanding of the mathematics.

The feedback from the exit forms was followed up by telephone interviews with a sample of eight teachers. They generally reinforced the positive feedback from the forms. Teachers attended because they were new to a module or hadn't taught it for some time, so wanted a refresher course. The teachers were generally agreed that the professional development event they had attended had met their expectations.

5.2 Live online Professional Development (LOPD)

Although the awareness surveys (Section 1) generally indicated a preference for face-to-face professional development, it is not possible for some teachers to attend these. This is mainly due to difficulties in obtaining daytime release from their teaching duties. To cater for their needs the FMSP runs a number of live online courses on various modules of AS and A level Mathematics and Further Mathematics, using virtual classroom software. These courses are typically 10 sessions of 90 minutes each, with numbers restricted to eight participants to encourage interaction. An advantage of LOPD is that sessions are recorded, so participants can replay them. In Phase 2 the evaluator sat in on two sessions from a module. The evaluator found the presentation from the tutor to be clear and comprehensive and that there was plenty of opportunity for the participants to do some mathematics and share any difficulties they were having.

Participants are asked to complete an online feedback form at the end of their course. The evaluator assessed a sample of these. Although there were some criticisms and suggestions for improvement, the general feedback was very positive, indicating that the teachers had achieved what they had hoped for through taking the course. This feedback was confirmed in telephone interviews with two teachers who had taken different LOPD courses.

5.3 Extended professional development courses.

The FMSP has been running the Teaching Further Mathematics (TFM) course for several years. This extensive course runs for fourteen months and is aimed at teachers of A level Mathematics who are starting to teach Further Mathematics or are considering doing so in the near future. Participants have the option of taking a Masters' degree unit through the course. Evaluation of the TFM course was included in both Phase 2 and Phase 3.

The Teaching Advanced Mathematics (TAM) course came under the brief of the FMSP in 2011/12. The TAM course was previously offered by Mathematics in Education and Industry (MEI) and has been running successfully since 2005. This too is a fourteen month course and is aimed at teachers who are teaching A level Mathematics for the first time, or who have limited experience of A level Mathematics teaching. Evaluation of this course was included in Phase 3.

5.3.1 Teaching Further Mathematics

A key part of the TFM course is study days at university, where participants meet with tutors for an intensive day of study and discussion on the mathematics covered in AS and A level Further Mathematics and effective ways of teaching it. The evaluator attended a study day as part of Phase 2. The day was broken up into sessions on various topics in mathematics and included the use of different teaching and learning resources. The evaluator considered the day to be well organised; it was demanding on the participants, but all were fully engaged.

The evaluation in Phase 3 comprised ten interviews with previous participants from the three years 2008-09 to 2010-11 on their views having taken the course and its subsequent impact on their careers. The interviews explored their reasons for taking the course and what they had got out of participating. These participants had taken the course to be brought up to date on curriculum and assessment requirements, refreshing themselves about the mathematical content and acquiring ideas to teach it. All agreed TFM is an excellent course; their knowledge and understanding of the mathematics has improved and they have gained lots of ideas and strategies for introducing and developing topics with students and making effective use of resources. The opportunities to meet other participants and the FMSP presenters, and to share experiences and ideas at the university days were particularly valued. Participants found this a demanding course with a heavy workload, but they also found it very worthwhile and offered no criticism of its structure, content or delivery. They felt an increased confidence to teach Further Mathematics, which resulted in a positive response in their students.

5.3.2 Teaching Advanced Mathematics

The report 'A Gateway to Teaching Advanced Mathematics', first published in 2008 is a collection of summative comments from previous participants about how they now perceive the course. This report is being updated to 2012; the Phase 3 report reviewed some of the feedback from more recent participants. This is generally very positive, with teachers saying how TAM made them more confident to teach at this

level, improved their knowledge and understanding of the mathematics and gave them ideas and resources to use in their teaching.

There were several other aspects to the evaluation of TAM in Phase 3. Firstly, the evaluator visited a school where there is a new sixth form, a current TAM participant and also three previous participants. The current participant was observed giving a lesson and then receiving feedback from the TAM Course Leader, which was constructive in praising the teacher but indicated areas of his teaching for consideration of how they might be improved. The three previous participants were interviewed; they each had a different reason for taking the course, but all were pleased to have done so, and had got from it what they wanted.

Secondly, the evaluator observed a meeting between the course organisers from the three universities who currently offer TAM and the Course Leader. There was detailed discussion on all aspects of the course, so that delivery would be consistent across the three universities. In particular, there was a lot of discussion on planning the university days, where participants meet to work on various aspects of teaching A level Mathematics, both with each other and with the course tutors. Subsequent to this meeting, the evaluator observed one of the university days and found the participants to be highly committed teachers, who were engaged in a range of activities throughout the day, all related to teaching A level Mathematics and/or the assignments for the Masters' degree unit that participants can opt in to through taking the TAM course.

Thirdly, these observations were followed up with some telephone interviews with some past and current participants. All these participants were generally positive about the course. Those with no previous experience of any A level teaching did find the course particularly demanding but were grateful for the support they received both from their tutors and also from other participants when meeting at the university days. Some participants found that the demands of the workload prevented them from following the Masters' degree option. However, all agree they had improved in their knowledge and understanding of the mathematics required to teach A level Mathematics, and in their confidence and ability to deliver interactive lessons, rather than textbook based lecturing. All would recommend the TAM course to other teachers.

It is clear that both the TFM and TAM courses are highly valued professional development courses and the FMSP should continue to offer them.

6 Stakeholder views

In Phase 2 of the evaluation the views of a range of stakeholders from the wider mathematical community were sought and sixteen responses were received. These included ten prominent academics, and representatives from professional bodies and subject associations. Their responses were all very positive about the FMSP and what it is achieving in promoting Further Mathematics. Many noted the increased uptake of Further Mathematics and the increasing number of establishments that offer it, noting there has been a major change of attitude towards Further Mathematics and that the FMSP has been instrumental in bringing this about. The academics noted in particular that the enhanced knowledge and problem solving abilities of students who had taken Further Mathematics made them more confident when they entered university to read STEM subjects and that students with Further Mathematics are better prepared to embark on higher education courses. The stakeholders also noted how the FMSP works flexibly and is able to respond to needs at both student and establishment level, and this is done successfully in a cost effective manner. In general, these stakeholders noted the high impact of the FMSP on mathematics education in England; they support it strongly and are advocates for continuation of the services that the FMSP offers, and for further development.

7 Conclusions

Each Phase of the evaluation has reported that the FMSP is making considerable progress towards achieving its aim of increasing the number of students who study both AS level and A level Mathematics and Further Mathematics, and developing the knowledge, expertise and confidence of teachers to enable them to teach Further Mathematics in their own school or college.

There has been considerable growth in the number of students taking A level and AS level Further Mathematics and Mathematics over the period 2005 to 2012. In particular, the number taking A level Further Mathematics has more than doubled over the time of operation of the FMN and the FMSP, showing the considerable impact that these organisations have had.

The FMSP offers a comprehensive range of support for both teachers and students, encompassing tuition, enrichment opportunities and revision for examinations for students, and advice and guidance and a range of professional development opportunities for teachers. Both students and teachers can access a vast online resource on the *Integral* website. All aspects of the activities of the FMSP have been evaluated over the three Phases, and this has shown that the activities of the FMSP are highly valued by both students and teachers.

Students who would not otherwise have been able to study Further Mathematics are generally grateful to the FMSP for providing them with the opportunity to do so, and for the support and guidance they received from their tutor. Teachers who have accessed the various aspects of support available to them are grateful for how it has improved their teaching or helped to inspire their pupils, and they want the activities of the FMSP to continue. Their response, in general, is very positive

There has been some criticism from both students and teachers on some aspects of the FMSP's activities, and these have been reflected in recommendations made in each report. The FMSP has responded, in terms of action taken or planned, to all of the recommendations made in both Phase 1 and 2, as was the case for the previous evaluations of the FMN. It is anticipated there will be a similar response following Phase 3. This shows how the evaluations have fed into the on-going development of the FMSP.

Through its Access to Further Mathematics events and the priority schools initiative, the FMSP is reaching out to more schools and colleges not currently offering Further Mathematics, with some subsequently introducing the subject to their curriculum.

The FMSP is an effective and successful organisation, evidenced by the growth in student numbers and the positive feedback from teachers when interviewed from the perspective of a range of activities. The work of the FMSP is highly valued by students, teachers and more generally by stakeholders, and this work should continue.

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