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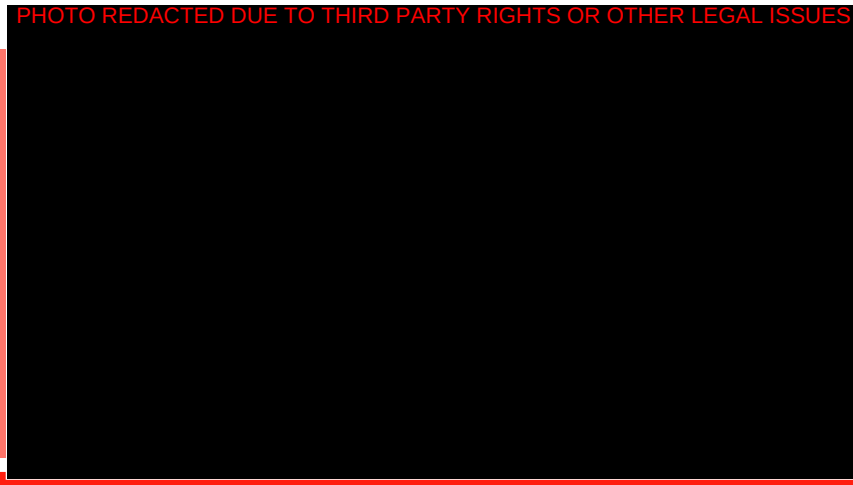
Evaluation of Further Mathematics Support Programme Pilot: Final Report



Evaluation of Further Mathematics Support Programme Pilot
Final Report

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Views expressed in this report are those of the researcher and not necessarily those of the Welsh Government

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Welsh Government Social Research, 19 September 2014
ISBN: 978-1-4734-2199-8

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Glossary of acronyms

A2	An examination which, in combination with an AS, forms a full A Level qualification
AES	Advanced Extension Award
AS	Advanced Subsidiary (A standalone qualification that also forms half of a full A Level qualification)
FEI	Further Education Institution
FMSP	Further Mathematics Support Programme
HEI	Higher Education Institution
HESA	Higher Education Statistics Agency
JCQ	Joint Council for Qualifications
LLWR	Lifelong Learning Wales Record
MEI	Mathematics in Education and Industry
PLASC	Pupil Level Annual School Census
STEM	Science, Technology, Engineering and Mathematics
STEP	Sixth Term Examination Paper
WED	Welsh Examinations Database
WIMCS	Wales Institute of Mathematics and Computational Sciences

1 Introduction to the report

1.1 This is the second of two reports from an evaluation of the Further Mathematics Support Programme (FMSP) pilot for Wales. The first (interim report) published in December 2013[1] set out findings from a process evaluation of the pilot and early indications of its impact. In that report it was recognised that the limitations of a short time series of relevant data, prevented robust conclusions being drawn, highlighting the need for a further, desk-based, review when a further years' data became available. This second report builds on the interim report, by presenting analysis of the more-up-to date data, and is intended to be read in conjunction with it.

1.2 This final report utilises an update of the available data to provide a more robust analysis of the outcomes and emerging impacts of the FMSP pilot. It provides further evidence, based on full GCE A Level examination data for 2012-13 and updated statistics for the numbers of undergraduate students studying science, technology, engineering and mathematics (STEM) subjects at UK universities. It also includes new data relating to participation by institutions and students in the pilot, and to the performance of students by gender for both schools and further education colleges in the pilot area and Wales as a whole.

1.3 The earlier interim report also provides comprehensive details about the background to the FMSP pilot, the approach and methodology to the study.

[1] http://wales.gov.uk/statistics-and-research/evaluation-further-mathematics-support-programme-pilot/?lang=en

2 Key findings and recommendations from the study

2.1 This section of the report presents an overview of the main findings of the updated evaluation. The detailed findings of the process and early impact evaluation were presented in the interim report[2]. The detailed findings underpinning the final impact evaluation findings are expanded upon in chapter 4, Outcomes and Impact, beginning on page 20, below.

Process issues

2.2 The interim evaluation report showed that stakeholders felt that the programme has been managed effectively and prudently, with a very hands-on, committed team. An active management committee reported feeling engaged with the project and other stakeholders were highly complementary of the approach taken to date.

2.3 Schools and colleges engaged with the FMSP. The pilot's stakeholders and management committee members were generally very positive about the pilot approach of providing a number of different 'routes' for pupils (and their teachers) to support them to achieve a further mathematics qualification. The evidence showed that pupils were able to access the most effective support to match their individual circumstances.

2.4 Awareness-raising has been underpinned by a thorough programme of publicity, backed by attendance at events and extensive personal contacts from the project team. Mathematics teaching staff in target schools generally had a good awareness of the pilot. Some stakeholders, however, were not sure how well the project has succeeded in engaging parents.

2.5 Student tuition was well received, despite the project having to charge a non-recoverable fee of more than £200 per student to schools. Face-to-face tuition was highly rated, especially when easily accessible to students, and

[2] http://wales.gov.uk/statistics-and-research/evaluation-further-mathematics-support-programme-pilot/?lang=en

online support was also appreciated, despite some issues of scheduling and student access. There were some concerns about the quality of support through the medium of Welsh, especially in terms of the delivery of enrichment events and the availability of tutors. In some areas, support through the medium of Welsh was not available and students used to being taught in Welsh felt uncomfortable using English terminology for complex concepts.

2.6 Face-to-face tuition was clearly the preferred method of teaching and learning amongst those interviewed, though teachers also spoke warmly of the added value offered by online materials, especially past papers and revision exercises. However, students were not always aware that resources they were using had originated on the FMSP site.

2.7 The general FMSP website was felt to be in need of further refreshment, in order to make it more engaging and broaden its appeal beyond those already committed to further mathematics.

2.8 Enrichment events were a very popular element of the pilot, comprising events targeted at KS4 Pupils and post-16 students, mathematics master classes held in university buildings, careers talks in schools and colleges and revision days in Swansea and Pembrokeshire. The inclusion of careers talks for pupils in years 10 and 11 and master classes for year 9 pupils were especially well received for their role in building pupils' interest in studying mathematics and STEM subjects at a higher level. The revisions sessions were also used as refresher courses by staff who had not been involved in teaching further mathematics for some time.

2.9 There is no one element of the pilot that has brought individual success, but it is the integrated approach to support that was valued by teachers and students alike

Monitoring and reporting

2.10 Currently the quarterly reports compiled by the FMSP team present an overview of school and college registrations to date and the provision of further mathematics by type of delivery setting, summary of recent and planned events, promotional activities and future priorities. However, the

information lacks benchmarking or reference to desired outcomes of the pilot, and details are not collected about the staff who are able to teach further mathematics in the supported schools.

Value for money

2.11 Assessing value for money of a pilot programme can be challenging, given the extent of capacity building and initial programme development entailed, in addition to the delivery of support for further mathematics itself. Measures to assess value for money were explored as part of the evaluation, but it was decided that narrow outcome measures such as additional attributable examination outcomes per pound invested did not adequately represent the overall value of the pilot and would be misleading.

Progress against outcomes

2.12 The FMSP was set six key outcomes at the start of the pilot. Although there is not yet sufficient time-series data to draw robust, long-term conclusions, the majority of outcomes have been achieved, at least in part. The evidence from the evaluation, as to how far these have been achieved is set out below.

Outcome 1: Increased numbers of students in the pilot area studying Further Mathematics at GCE A/AS levels, over the life of the pilot.

2.13 There has been a clear increase in the number of students undertaking A Level Further Mathematics in the pilot area, although the data is less conclusive in relation to AS level at present[3]. Northern Ireland was chosen as a suitable counterfactual comparison to Wales, as no discrete further mathematics support initiative has taken place there (unlike in England), and it has a similarly structured post-16 education system to Wales (unlike Scotland). Whilst examination entries have clearly increased in the pilot area and in Wales to a lesser extent, figures have not changed in Northern Ireland.

[3] AS (Advanced Subsidiary) is the first half of a full A Level course, and is usually studied during year one of a two-year A level course. Students with an AS level pass who do not wish to continue to the full A level may 'cash in' their AS level, receive a certificate and include it in their list of qualifications attained.

In Wales, there has also been an increase in the numbers of students studying mathematics, although the rate of increase has been lower than that for further mathematics.

2.14 Data from FMSP registrations shows a year on year increase in the number of students studying further mathematics at both AS and, with the exception of a very small decrease in 2013, at A Level in the pilot area. Lifelong Learning Wales Record (LLWR) data and Welsh Examinations Database (WED)[4] data on examination entries shows a sharp rise in the level of A2 Level entries since the beginning of the pilot, increasing four-fold from 21 in 2010 to 105 in 2011 before falling back slightly to 88 in 2013. There was also an increase across Wales during that period, where the number of A2 entries more than doubled from 142 in 2010 to 281 in 2013. However, whilst the FMSP registrations show an increase in AS level entries in the pilot area, this is not reflected in the LLWR and WED data, which shows 50 entries in 2010, falling to 31 in 2011 before increasing to 46 in 2013. There is a known issue which may account for the lack of consistency between the FMSP data and the examinations data; only AS Levels which have been "cashed in" (that is the qualification has been claimed and a certificate awarded) appear within the WED database. Where the student continues to study for the A2 paper, or wishes to re-sit some AS level modules, the AS level would not be 'cashed in' and would not appear within the WED.

2.15 If the proportion of examination entries in further mathematics is looked at as a proportion of entries in mathematics, there has been a relative increase in the pilot area, against the rest of Wales.

2.16 Importantly, there are also emerging signs of an increase in further mathematics attainment levels, especially at A Level; both in terms of passes at grades A*-E and at the highest levels (A*A) in both the pilot area and the rest of Wales. In terms of passes at the highest levels (A*A), between 2010

[4] WED provided details of examination entries and attainments in schools. LLWR provided details of entries and attainments in FE colleges. More details of the datasets used and the methods of analysis are provided in the interim report.

and 2013, attainments in the pilot area increased more than four-fold (from 11 to 48) and in the rest of Wales by more than half (from 69 to 105).

2.17 However, whilst further mathematics entries from both genders have increased in the pilot area, the proportion from females reduced between 2010 and 2013, although data for 2013 shows a slight reversal of the sharp fall in the proportion of female entries in 2012. This would indicate that the pilot has been more successful in engaging male than female students.

Outcome 2: More schools and colleges in Wales offering Further Mathematics, either individually, or via consortia.

2.18 On this measure, good progress has been made in the pilot area: In 2010, 21 out of 32 school sixth forms and FE colleges in the pilot area offered further mathematics. By February 2014, this number had increased to 25 out of 29 centres in the area[5].

2.19 The number of centres delivering further mathematics in a classroom setting (either timetabled or at lunchtime / after school) rose from 16 in 2010 to 24 by 2013, but fell back slightly to 21 in 2014. Over the same period, the number of schools without classes, but with a single supervised student or up to two unsupervised students fell from five to two.

2.20 Whilst not all schools were actually offering further mathematics by 2013, the FMSP secured registrations from all sixth form centres in the pilot area by 2013, along with the majority of 11-16 schools in the region[6].

Outcome 3: Increased numbers of mathematics teachers in Wales who are trained to teach further mathematics.

2.21 There is no clear means of measuring the "stock" of teachers qualified to teach further mathematics in Wales and so this outcome could not be assessed effectively in the course of the evaluation. Delivery of continuous

[5] Mergers of two colleges into one and four sixth forms into two brought about the reduction in total centres from 32 to 29.
[6] None of the 11-16 schools and not all of the 11-18 schools that were registered with FMSP delivered GCE A Level Further Mathematics tuition.

professional development (CPD) for teachers was not part of the original pilot programme and online support was introduced in 2013.

2.22 Unlike the programme in England, the pilot FMSP in Wales did not initially include specific resources to address CPD issues; relying instead on the online resources available on the Mathematics in Education and Industry (MEI) website. The call for teacher CPD within the pilot area led to the start of Live Online Professional Development from October 2013, which has already proved a very popular resource. A wider CPD programme is now in preparation, underpinned by a brief survey seeking teacher's views about CPD for Mathematics.

2.23 Whilst no data is available about further mathematics qualification levels amongst teachers, details about qualifications to teach mathematics itself may provide clues as to the importance of mathematics in the curriculum. The number of all secondary teachers trained in mathematics and registered with GTCW increased from 1,204 in 2009 to 1,469 in March 2014, accounting for 10 per cent of all teachers by that date[7] and second only to the number of English teachers (10.4 per cent of the workforce). The data shows that 76 per cent of those teaching mathematics at secondary level[8] were known to be trained in the subject; the highest for any subject area. Further, the number of newly qualified mathematics teachers registered with GTCW increased from 70 in 2009 to 84 in 2013, before falling back slightly to 75 in 2014 and accounting for 12 per cent of the total at that time; the largest proportion of any subject specialism apart from English.

Outcome 4: Overall raised awareness among students and their parents of the importance of studying mathematics at higher levels.

2.24 The interim evaluation report set out that evidence of awareness of the opportunities offered by studying further mathematics is difficult to find,

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[7] http://www.gtcw.org.uk/gtcw/images/stories/downloads/Annual%20Statistics%20Digest/Annual_Stats_14_E.pdf

[8] In English medium schools. http://www.gtcw.org.uk/gtcw/images/stories/Statistics/Welsh__English_Medium_Schools_Comparison_February_2014_E.pdf

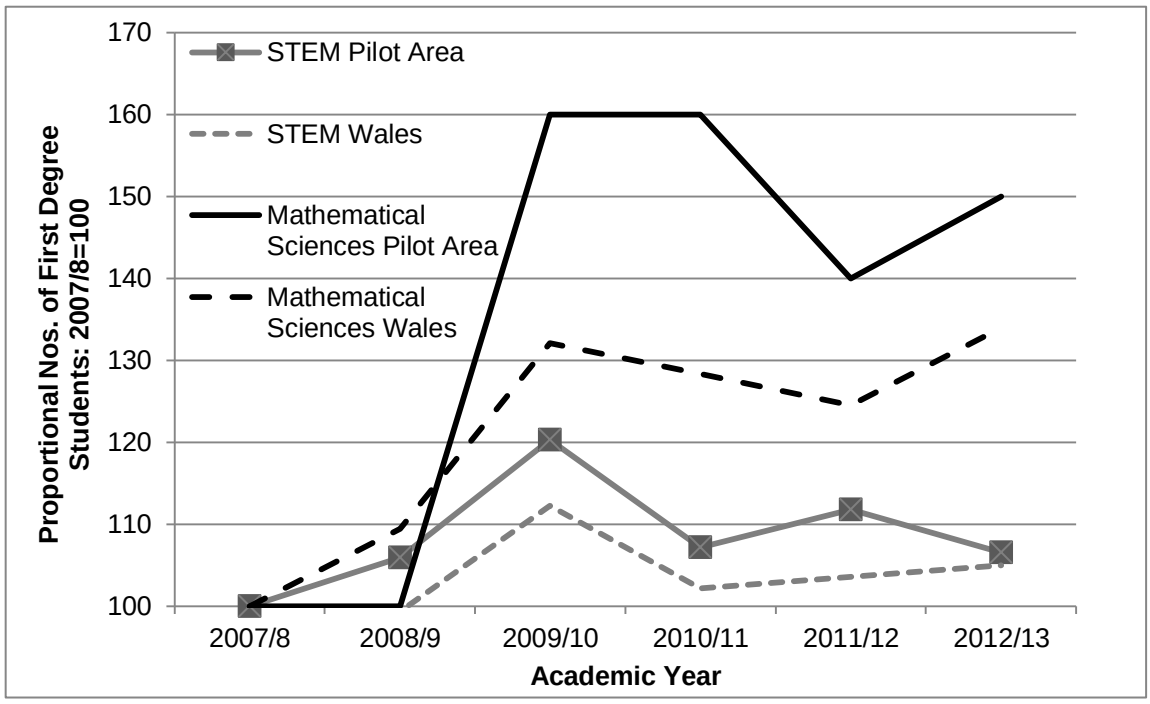
although interviews with students and teachers suggested a general understanding of the potential of the subject to support higher level study. The increased take up of further mathematics AS/A Level provision and increased applications for undergraduate further mathematics and STEM courses corroborates this.

Outcome 5: Increased numbers of students from Wales applying to study higher education courses in mathematics and related subjects, such as engineering and physics.

2.25 Higher Education Statistics Agency (HESA) data shows a clear increase in the number of enrolments to mathematics courses from the pilot area over the last four years; from 50 in 2007-8 to 75 in 2012-13[9]. This 50 per cent increase in mathematics enrolments from the pilot area outstripped the growth from Wales as a whole, which was 34 per cent, although the increased rate of growth began before the pilot commenced and the data appears quite volatile. Between 2007-8 and 2012-13, enrolments onto STEM subjects increased from 1,530 in 2007/8 to a peak of 1,840 in 2009/10 before falling off to 1,630 by 2012/13.

[9] In the interim evaluation report, figures for Welsh domiciled students in all years of undergraduate degrees were used. This report uses improved data for first year students only, reflecting the changes since the beginning of the pilot more clearly.

Figure 1. First Year, First Degree Students Domiciled in SW Wales / Wales on Mathematical Sciences / STEM Courses in UK HEIs, 2007-2013[10]



Source: Welsh Government / HESA 2014

2.26 According to Universities and Colleges Admissions Service (UCAS) Data[11] there is significant variation by country in the proportion of 18 year olds applying to university across all subjects. In 2014, 47 per cent of 18 year olds from Northern Ireland applied, whilst the figures for England, Scotland and Wales were 35 per cent, 31 per cent and 30 per cent respectively. Hence, although the rate of Welsh students enrolling on mathematics courses expressed as a proportion of all subjects was broadly in line with that of English students, the overall rate of Welsh 18 year olds applying for mathematics subjects still lies below those of students from England[12].

[10] Enrolments indexed back to 2007/8 using 2007/8 figure as base=100.
[11] Applicant statistics, (interim) May 2014: UCAS Analysis and Research.
[12] UCAS figures on admissions

Table 1. Applications for Mathematics and Stem Subjects at UK Universities.

Academic Year		2010	2011	2012	2013
Applications as a proportion of18 year olds percentages					
STEM Applications	Wales	*93*	*102*	*103*	*110*
	England	*92*	*83*	*87*	*80*
Mathematical Sciences Applications	Wales	*4.1*	*3.9*	*3.9*	*4.4*
	England	*4.5*	*4.7*	*4.5*	*4.9*
All Subjects	Wales	*230*	*240*	*240*	*240*
	England	*290*	*300*	*270*	*290*

Source: UCAS (June 2014 Deadline) / ONS Mid-year Population Estimates for 18 year olds.
Note; Applicants can apply for more than one course and may be ages other than 18.

2.27 Wales experienced a 3.2 per cent increase in applications across all subjects, from 91,840 in 2013 to 94,810 in 2014[13]. This was compared with an increase at UK level of 3.6 per cent (from 2,243,190 applicants to 2,325,060).

Outcome 6: Improved transition of students from further to higher education courses in mathematics, or from courses which have a significant element of mathematics, thus benefiting the wider economy.

2.28 Fieldwork for the evaluation showed that undergraduate students were clear that transition from A Level to degree courses in mathematics, and to a lesser extent STEM subjects is made considerably easier by taking further mathematics at A/AS Level. Generally, however, this advantage is eroded after the first year of undergraduate study.

2.29 There was general consensus amongst STEM students and lecturers interviewed, that further mathematics at A Level was a clear advantage in the first year at university.

[13] file:///J:/(P-697)%20Evaluation%20of%20the%20FMSP%20Pilot/2014%20Update/june-2014-deadline-analysis-subjects.pdf

Recommendations

(i) The pilot has proved successful in building engagement in further mathematics in the pilot area and the extension to Rhondda Cynon Taf and North West Wales is to be welcomed, given the increases in engagement achieved in the original pilot area. This approach should be allowed to consolidate by maintaining support for the extended pilot, whilst considering a change of emphasis within the initial pilot area away from direct support, to building sustainability through capacity building amongst teaching staff and sixth form centres. Regional consortia should be engaged in promoting further mathematics as part of their work in improving the education offer to young people. This should include support for capacity building in all areas of Wales, ensuring training for continuous professional development (CPD) is available as a minimum.

(ii) The full breadth of support should be continued where possible within the context of available resources, in recognition of the value of an integrated approach to developing awareness, engagement and support for pupils, without prioritising or discontinuing any individual elements. The report illustrates that there is existing “spillover” of benefits into regions of Wales beyond the pilot area and a withdrawal of support would have wider impacts than on the pilot area alone.

(iii) More needs to be done to continue to promote further mathematics to female students and encourage them to take further mathematics at AS/A2 level, as the gender gap in examination entry levels increased during the period up to 2012, despite indications at an all-Wales level of improvements in 2013. Actions could include enrichment events targeted at female students, presenting case studies and using gender-specific materials

(iv) Attention needs to be paid to the quality of provision, support and online revision materials in the medium of Welsh, to ensure equality of access and standards to all students in Wales. The content of materials should reflect developments in the syllabus that are due to be made in the near future.

(v) The evaluation has shown the importance at an institutional level of school principals and senior management team members promoting further

mathematics provision – not least because of the financial implications of support. Brokerage work, involving the FMSP team and regional consortia, targeted at this senior level could help to build commitment and embed further mathematics in a sustainable manner.

(vi) It is imperative that continuous professional development (CPD) continues to be incorporated more fully into the FMSP in Wales. The clear demand for online resources provides compelling evidence of need, which can be built upon through current research by the FMSP team. Research with teaching staff has revealed a widespread lack of confidence at best and in many cases staff have not received training in delivering further mathematics at AS/A Level. Future CPD should incorporate a module on use of online resources, to enable more effective use to be made of these. The accreditation of CPD, for example, as credits towards a MEd or similar could be investigated with relevant HEIs. Collection of data by the FMSP project team relating to the number of teachers qualified to teach further mathematics would allow for tracking of progress and this should be considered.

(vii) Collaboration and networking across schools should be encouraged to share resources beyond the formal collaboration resulting from the Regional Learning Partnership and 14-19 Partnership arrangements. In particular, any actions to increase levels of face to face tuition at convenient times and locations would be welcomed by practitioners and students alike.

(viii) The project management and delivery of the pilot have been acknowledged as generally very effective. The quality and clarity of progress reporting has been reviewed, to build understanding of the achievements of the pilot and of where barriers to success occur. However, there is room for more consideration of progress towards all programme targets, following the pattern suggested in this report, to clearly present activities delivered by quarter, progress against outcomes and future plans and priorities. Securing meaningful monitoring data will mean some additional collection and analysis of data by FMSP, Welsh Government and regional consortia, most notably:

a) Monitoring outcomes in schools and colleges supported by the pilot, in relation to entries at AS and A Level and attainment levels achieved. (Responsibility: Regional consortia) ;

b) Qualitative monitoring by learning providers of the perceptions and experiences of beneficiary students, using a standardised online questionnaire that can build from year to year (Responsibility: Learning providers);

c) An annual statistics report from LLWR and WED on AS/A Level Further Mathematics and Mathematics entries by gender, pilot/non-pilot area(s) and consortium area. (Responsibility: Welsh Government);

d) GTCW Data for teachers qualified to teach mathematics and proportion of teachers delivering mathematics who are trained in their subject. (Responsibility: FMSP);

e) Number of staff qualified to teach further mathematics in the pilot area, consortium areas, and Wales as a whole. There is not dataset for this at present and it may need to be taken on as a research exercise by the Regional Consortia, recognising that some teachers may be qualified for certain modules only. (Responsibility: Regional consortia);

f) An annual compilation of HESA data for first year, Welsh domiciled students at UK HEIs enrolled on mathematics and STEM subjects, again by pilot/non-pilot area, consortium area and all Wales. This will need to be drawn from raw HESA data as a separate analytical exercise. (Responsibility: Welsh Government). It may be worth considering monitoring UCAS applications, as well as enrolments, to understand any lessons in terms of the success rate of applications for further mathematics against other subjects (Responsibility: FMSP / Regional consortia); and:

g) A comparison of JCQ data for AS/A Level entries in Wales, England and N Ireland, along with an exploration of whether detailed data can be secured from comparator nations for 17/18 year olds in maintained settings. (Responsibility: FMSP / Regional consortia / Welsh Government);

(ix) The FMSP Website should be further updated and enhanced, to provide a more effective marketing and engagement tool for the pilot and a stronger identity for support in Wales. More work could be done to alert teachers to the breadth of materials available on the site; possibly including a quick guide to what is available. (Responsibility FMSP);

(x) Where online activities are provided, their availability requires greater promotion and publicity, and they must 'work' in terms of easy, straightforward connectivity. Timing of sessions also requires more consideration. (Responsibility: FMSP);

(xi) Finally, there is a vulnerability in the pilot, in that it has substantially relied on the high level of commitment and support from the programme leader. Plans for any future investment will need to be mindful of the critical nature of this role and a succession plan needs to be formulated as a matter of urgency. (Responsibility: FMSP);

3 Background to the Evaluation

3.1 The FMSP initially covered Carmarthenshire, Neath Port Talbot, Pembrokeshire and Swansea and the Welsh Government originally intended that it run between July 2010 and October 2013. In early 2013, the decision was taken to expand and prolong the pilot and from April 2013, FMSP support was also provided in Anglesey, Conwy, Gwynedd and Rhondda Cynon Taf. At this time the pilot programme was extended to March 2014. Following publication in December 2013 of the interim report, the Minister announced that more funding would be made available to consolidate and continue the programme up to April 2016.

3.2 Like the interim report, this final report focuses on the initial pilot area in SW Wales and its impacts on students from the region.

3.3 The pilot was initially funded to a total of £581,485 between 2010 and 2014 from Welsh Government and has been managed by the Wales Institute of Mathematical and Computational Sciences (WIMCS). The additional funding to extend the programme to April 2016, was for £225,000 and took the total funding provided since 2010 to £806,485.

3.4 Support offered to schools and colleges through the FMSP Wales includes:

- Student tuition for AS/A Level Further Mathematics;
- Free single user teacher access to the Mathematics in Education and Industry (MEI) Resources Website (supporting all AS/A2 Level Further Mathematics specifications plus Additional Mathematics and GCSE extension resources);
- Mathematics enrichment courses for students in Key Stage 4 and post-16, such as mathematics master classes, mathematics career talks and revision events;
- AS and A2 Mathematics and Further Mathematics Revision Days.

The evaluation

3.5 The evaluation set out to provide an assessment of both the process and impacts of the pilot programme to date and the extent to which it is meeting its objectives. Approaches to the counterfactual (i.e. what would have happened in the absence of the pilot) were trialled, using spatial comparisons, (pilot area vs. Wales, England and Northern Ireland) and time series (pre-pilot and during pilot). In November 2013 the project steering group took the decision to publish the findings relating to the process evaluation and evidence of early impact, in the form of an interim report. The group also agreed to extend the evaluation period for a further nine months to allow for updates to student participation, attainment and progression data to be incorporated in this final report.

4 Detailed findings: Outcomes and impacts

4.1 The specification for the FMSP identified six outcomes to be achieved by the end of the pilot. These were all comparative targets, relating to **increases** in provision and participation, rather than hard numeric targets against a baseline position.

4.2 The outcomes were:

- Outcome 1: Increased numbers of students in the pilot area studying further mathematics at GCE A/AS levels, over the life of the pilot
- Outcome 2: More schools and colleges in Wales offering further mathematics, either individually, or via consortia
- Outcome 3: Increased numbers of mathematics teachers in Wales who are trained to teach further mathematics
- Outcome 4: Overall raised awareness among students and their parents of the importance of studying mathematics at higher levels
- Outcome 5: Increased numbers of students from Wales applying to study higher education courses in mathematics and related subjects, such as engineering and physics
- Outcome 6: Improved transition of students from further to higher education courses in mathematics, or from courses which have a significant element of mathematics, thus benefiting the wider economy.

4.3 In this section of the report, we examine the progress made against each outcome, within the constraints of available data and draw some conclusions about the overall efficacy of the pilot. This analysis builds on that in the interim report, through:

- additional FMSP data for participation in further mathematics,
- all 2013 attainment data for AS/A2 examinations,
- HESA data for Welsh-domiciled, first year undergraduate students on STEM related courses in 2013-14 and,
- the latest data on qualifications of teachers in Wales

Outcome 1: Increased numbers of students in the pilot area studying further mathematics at GCE AS/A2 levels, over the life of the pilot.

4.4 There is a stark disparity in data between the numbers of students recorded by FMSP as studying for AS/A2 examinations in further mathematics and the data returns held in the LLWR and WED for the number of examination entries and attainments. Whilst no clear explanation is available, it is likely that some students' AS Levels are not counted in their own right, but they are combined with A2 results as part of their A Level qualifications, which are then recorded in entry and attainment data returns. At the same time, some students are likely to embark on an AS or A2 further mathematics course without entering for the exam, but instead to boost their grades in mathematics (where there are common modules across the two subjects, such as Mechanics 2 or Statistics 2[14]) and others will not complete the course due to workload.

4.5 Data from FMSP shows that there were 60 students studying A2 Further Mathematics and 129 students studying AS in Years 12 or 13 in state-funded sixth forms or FE in the pilot area in 2010-11. By 2013-14, this had increased to 97 A2 Level and 168 AS Level students studying further mathematics in the region.

Table 2. Students Studying Further Mathematics: AS/A2 Levels, 2010-14

Year	AS	A2	Total
2010-11	129	60	189
2011-12	164	66	230
2012-13	169	101	270
2013-14	168	97	265

Source: FMSP Registration Data

4.6 Whilst the available sources of data do not provide comprehensive and reliable figures for both the pilot area and Wales, and it is therefore not

[14] Mechanics 2 and Statistics 2 are optional papers in Mathematics A level and in Further Mathematics AS level. These papers are a requirement for Further Mathematics A level. An example of syllabuses for these qualifications is available on the website of the WJEC: http://www.wjec.co.uk/qualifications/qualification-resources.html?subject=Mathematics&level=GCEASA

possible to be certain about the total number of students *studying* further mathematics, a worthwhile proxy is the number of examination *entries* at AS/A2 Levels, taken from the LLWR for FE students and WED for school sixth form pupils. Table 3 below shows the change in entries over time in the pilot area, demonstrating an increase in A2 entries from 17 in 2007-8 to 88 in 2012-13, change in AS Level entries from 17 in 2007-8 to 46 in 2012-13, and changes in combined AS/A2 entries from 34 in 2007-8 to 134 in 2012-13, albeit with large fluctuations in numbers between these dates. However, these 134 entries were in the context of 265 students said to be studying within the pilot area.

Table 3. Further Mathematics Entries at AS/A2 Levels: Pilot Area FE and Schools 2008-2014

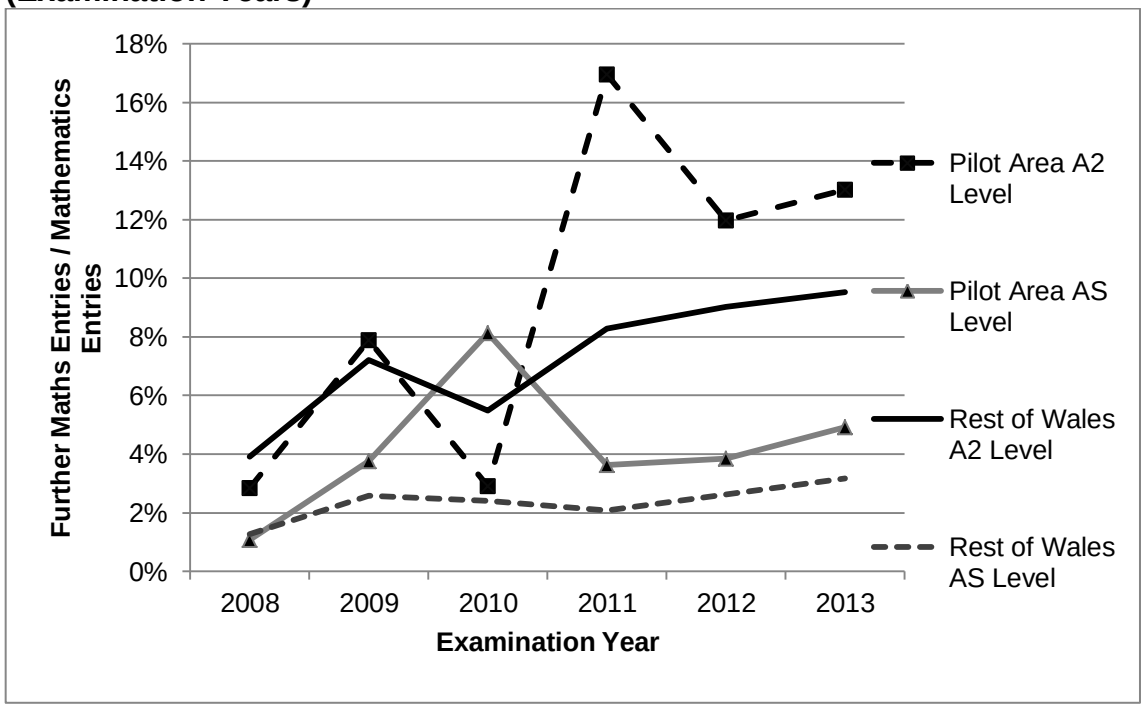
Examination Years		2008	2009	2010	2011	2012	2013
A2 Level	FE	10	30	7	87	61	60
	Schools[15]	7	24	14	18	26	28
	Total	17	54	21	105	87	88
AS	FE	10	31	47	28	27	39
Level	Schools	0	1	3	3	7	7
	Total	17	32	50	31	34	46
AS/A2	Total	34	86	71	136	121	134

Source: LLWR / WED. WED Data for state schools. LLWR A Level data for 17-18 year olds and AS Level data for 16-17 year olds.

4.7 Another approach to looking at changes in the rate of Further Mathematics entries is to take, from the most reliable sources available (WED and LLWR), further mathematics examination entries as a proportion of mathematics entries and to explore changes over time.

[15] Excludes independent schools

Figure 2 Further Mathematics Entries as a Proportion of Mathematics Entries: A2 and AS Levels: Pilot Area vs. Rest of Wales 2008-2013 (Examination Years)

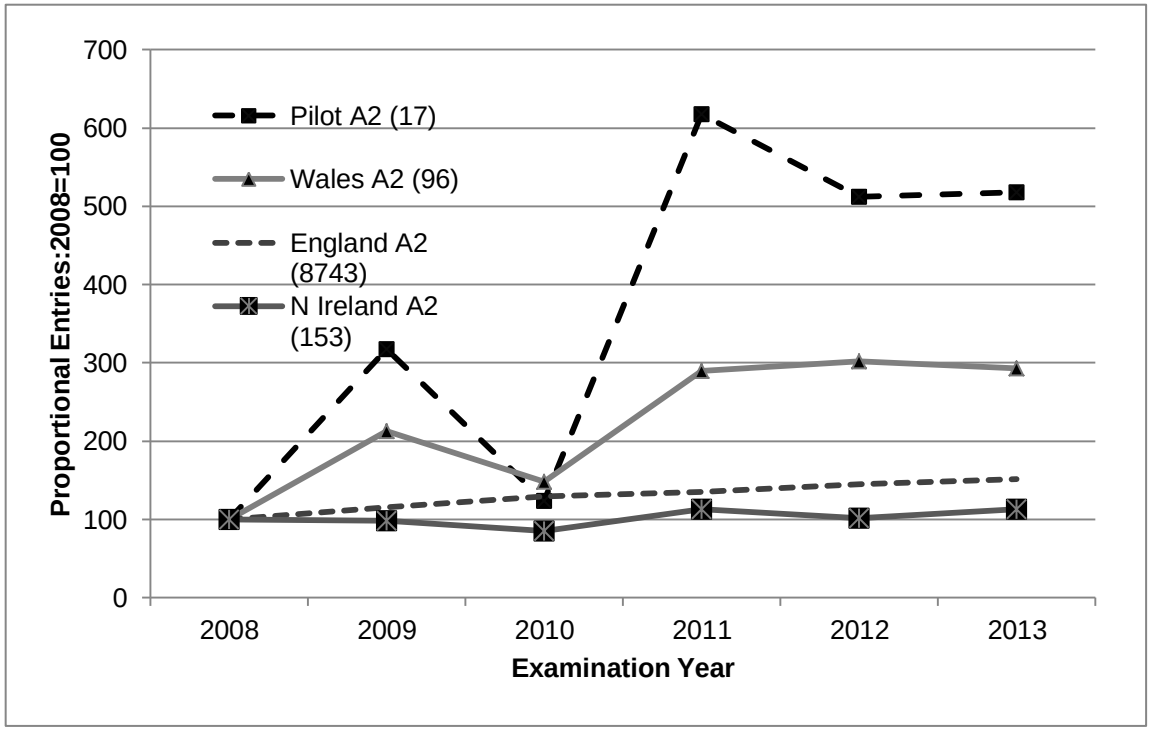


Source: LLWR / WED/ Miller Research

4.8 As before, this shows a step change in the proportion of A2 Level Further Mathematics entries in 2011 in the pilot area and a consistently higher proportion of further mathematics entries at AS Level than in the rest of Wales from 2009 onwards. It is notable that entries had already begun show limited signs of increasing before the pilot FMSP commenced.

4.9 Given that the FMSP has engaged with a substantial number of schools outside the pilot area and that this may have impacted on engagement levels, it may be more illustrative to compare changes in examination entries with Northern Ireland, where no support for further mathematics is in place and England, where long term support has been in place. Figure 3 shows how the rate of entries as a proportion of the 2008 baseline, has since changed in each UK country.

Figure 3 Further Mathematics: A2 Entries: Pilot Area vs. Wales, Northern Ireland and England 2008-2013 (Examination Years. Indexed to 2008)



Source: JCQ for Wales, England N Ireland. WED/LLWR for Pilot Area. Figures in brackets are entries for 2008. Note JCQ data includes independent schools, other settings and all ages, WED/LLWR data are for 16 and 17 year olds in maintained settings only.

4.10 This shows that whilst levels of engagement in further mathematics remained relatively constant in Northern Ireland over the period and England experienced a gradual rise in numbers, there was a substantial increase in engagement in the pilot area in the period 2011 to 2013, and a smaller rise in engagement in the rest of Wales. The rate of A2 Further Mathematics entries as a proportion of mathematics entries in Wales was 7 per cent in 2008[16] and 11 per cent in 2013, whereas in England it was 15 per cent in 2008 and 16 per cent in 2013. In Northern Ireland the proportion fell slightly over the same period from 6 per cent to 5 per cent. However, the increase in Wales should be seen in the context of starting from a low baseline, in that by 2013, there were approximately 11.0 Further Mathematics entries per 1,000 population

[16] JCQ Data. A level Further Mathematics entries, 2013: Wales=416, England=13,232. Joint Council For Qualifications Provisional GCE A Level Results - June 2013 http://www.jcq.org.uk/Download/examination-results/a-levels/a-as-and-aea-results-summer-2013

(of 18 year olds) in Wales, against a corresponding figure of 20.4 in England.[17]

4.11 The FMSP should help to increase the quality of tuition and support, as well as the numbers of students engaged. Hence the extent to which students achieve a qualification on completion of their course is also important. Data for achievements of further mathematics A*-E grades as a proportion of A*-E grades in mathematics are shown below for the pilot area and rest of Wales. These are included as a proxy for the quality of tuition in further mathematics and show indicative signs of an increase in achievements at A Level between 12 per cent in 2011 and 15 per cent in 2013 in both the pilot area and the rest of Wales, with some signs of growth (between 4 per cent and 9 per cent) in terms of AS Level data.

Table 4. Further Mathematics Attainments at A*-E as a Proportion of Mathematics Achievements; 2008-2013

Per Cent		2008	2009	2010	2011	2012	2013
A Level	Pilot Area	*3*	*8*	*3*	*12*	*12*	*15*
	Rest of Wales	*4*	*7*	*5*	*8*	*9*	*13*
	Total	*7*	*15*	*8*	*20*	*21*	*28*
AS Level	Pilot Area	*1*	*3*	*4*	*2*	*4*	*5*
	Rest of Wales	*1*	*3*	*2*	*2*	*3*	*4*
	Total	*2*	*6*	*6*	*4*	*7*	*9*

Source: LLWR / WED / Miller Research

4.12 Another variable to consider is the proportion of A* and A grades achieved in Further Mathematics. Table 5 below shows the number of A Level achievements at A*-A grades[18] in the pilot area between 2009 and 2013, along with this number as a proportion of A*-A results in the rest of Wales. In both cases, there appears to be a step change in 2011, which is broadly sustained in 2012. Students in the pilot area accounted for 23 per cent of the A*-A grades in Wales in Further Mathematics in 2008, rising to 31

[17] ONS Mid-year Population Estimates for 18 year olds: Wales=37,860, England=650,210. https://statswales.wales.gov.uk/Catalogue/Population-and-Migration/Population/Estimates/NationalLevelPopulationEstimates-by-Year-Age-UKCountry

[18] A* was only introduced as a grade option in 2010.

per cent in 2013. A more robust measure will be to see whether this level persists over the medium term.

Table 5. Further Mathematics Achievements at A*A: Pilot Area vs. Rest of Wales, 2008-2013

Numbers and percentages		2008	2009	2010	2011	2012	2013
A Level	Pilot Area Achievements, Numbers	12	26	11	40	44	48
	Rest of Wales Achievements, Numbers	41	79	69	89	115	105
	Pilot Area / Rest of Wales, %	*29*	*33*	*16*	*45*	*38*	*46*
	Pilot Area / Wales Total, %	*23*	*25*	*14*	*31*	*28*	*31*

Source: LLWR / WED / Miller Research

4.13 The data can also be analysed by the proportion of A* and A grades achieved in Further Mathematics as a percentage of A* and A grades achieved in mathematics. This can potentially control for the presence of a more able cohort of students in a given year and validate data which demonstrates an increase in the proportion of A* and A grades. As is shown in Table 6 below, the rate of A-A* in further mathematics has grown more strongly in the pilot area than in the rest of Wales, in relation to A-A* mathematics grades as well.

Table 6. Further Mathematics Achievements at A*-A as a Proportion of Mathematics Achievements at A*-A; 2008-2013

Per Cent		2008	2009	2010	2011	2012	2013
A Level	*Pilot Area*	*5*	*9*	*4*	*16*	*15*	*22*
	Rest of Wales	*5*	*9*	*8*	*10*	*13*	*11*

Source: LLWR / WED / Miller Research

4.14 The data post-2011 appears to validate a proportional increase in achievement of top grades at A Level, with particular growth in the pilot area in 2013, in contrast to a slight fall in the rest of Wales.

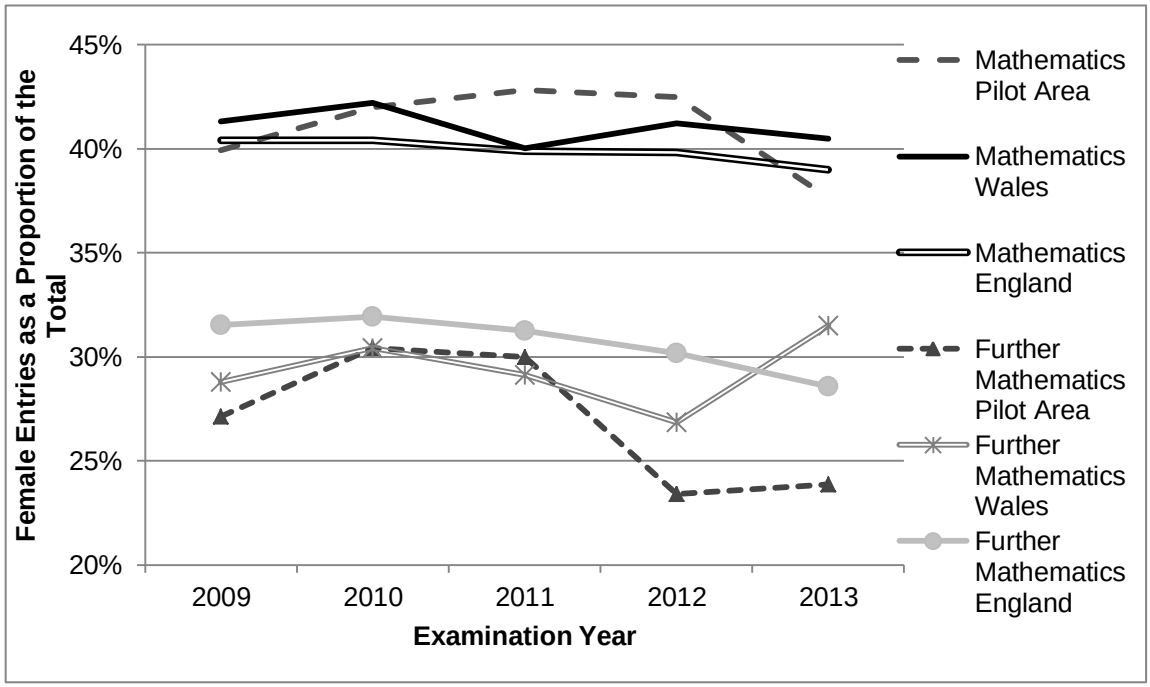
4.15 Equality by gender was also explored. In the pilot area, female students accounted for only 24 per cent of A Level Further Mathematics entries in 2013 and the interim evaluation showed that the relative proportion of

female further mathematics A2 entries in the pilot area has fallen as overall numbers have risen in association with interventions from the pilot.

4.16 When comparing the proportion of female further mathematics entries to female maths entries, a similar pattern can be seen. Female participation in Mathematics A2 examinations has remained relatively constant in both the pilot area and Wales as a whole[19]. The data shows that the gender imbalance in further mathematics has grown to a larger extent in the pilot area than in the rest of Wales between 2008 and 2013, suggesting that the pilot has been relatively successful in engaging male students, but may need to focus some attention on how to attract more female students into the subject. Across Wales as a whole, there was a sharp increase in the proportion of female A2 Further Mathematics entries in 2013, although this was not reflected in the pilot area. This increase follows a fall in the proportion of female entries in 2012, illustrating the volatility of the data over a short period. In England during the six years between the creation of the FMSP in 2004 and 2010, the proportionate increase in participation by female students was broadly in line with that for male students, although at a much lower level in numeric terms. However, since 2010, there has been a steady decline in the proportion of female entries for both mathematics and further mathematics in England.

[19] In the pilot area, female entries accounted for between 38 and 43 per cent of all mathematics A Level entries between 2009 and 2013, whilst in Wales as a whole, the range was between 40 and 42 per cent.

Figure 4. Further Mathematics and Mathematics A2 Examinations: Female Entries as a Proportion of Total for Pilot Area, Wales and England



Source: LLWR / WED (for Pilot Area and Wales) / JCQ (for England). Note the LLWR/WED and JCQ datasets are not strictly comparable, as discussed earlier in this report.

4.17 Finally, the interim evaluation report suggested that the data could be used to explore whether, due to the FMSP, an increase in the numbers of students with lower grades at GCSE[20], or those living in deprived areas, participating in further mathematics might be observed. However it was found that this analysis would require data linking work to create individual-level records for further mathematics students, their GCSE scores and postcode-related deprivation information from the Welsh Index of Multiple Deprivation. Such linking work was beyond the scope of this project.

[20] Or equivalent.

Outcome 2: More schools and colleges in Wales offering further mathematics, either individually, or via consortia.

Schools and colleges engaged

4.18 When the pilot began in 2010, it was identified that there were 27 secondary schools with sixth forms in the pilot area, of which 13 were English medium maintained schools, 11 were Welsh medium maintained schools and three were independent. There were five further education colleges to begin with, but the merger of Gorseinon and Swansea Colleges in 2010 to form Gower College reduced this to four. Also, in 2012, the number of school sixth forms was reduced to 25, following the merger of four sixth forms into two.

4.19 The FMSP had secured registrations from all maintained sixth form centres (in schools and colleges), from the majority of 11-16 schools, and three out of four independent schools in the pilot area by 2013. Table 7 shows the coverage in March 2014.

Table 7. Coverage of FMSP in the Pilot Area, March 2014

School Categories		Schools/colleges in the Pilot Area				
		Carmarthen shire	Neath Port Talbot	Pembroke-shire	Swansea	Total
Total schools in the area	11-16 schools	5	9	0	7	21
	11-18 schools	8	2	8	7	25
	FE Colleges	1	1	1	1	4
	Independent schools	2	0	1	1	4
	Total	16	12	10	16	54
FMSP Wales Registered	11-16 schools	4	5	0	7	16
	11-18 school	8	2	8	7	25
	FE Colleges	1	1	1	1	4
	Independent Schools	2	0	1	0	3
	Total	15	8	10	15	48

Source: FMSP

4.20 In addition to schools and colleges in the original pilot area, by March 2014, FMSP had secured a further 23 registrations from schools in the extended pilot area, incorporating Anglesey, Gwynedd, Conwy and RCT.

There were also 69 registrations from sixth form centres in other parts of Wales.

4.21 Table 8 shows the change in both the number of sixth form centres in schools and colleges in the pilot area between 2010 and 2014, and the growth in the number and proportion of these delivering further mathematics. In 2010, there was provision in 21 out of 32 centres, whilst in 2013 the proportion had changed to 25 out of 29 centres.

Table 8. Number of Schools with Further Mathematics Students in the Pilot Area in 2010 - 2014

	2010	2013	2014
No. of school sixth forms in the pilot area	27	25	25
No. of FE colleges in the pilot area	5	4	4
No. of school sixth forms with FM students	16	22	21
No. of colleges with FM students	5	4	4
Proportion of centres with FM students %	*66*	*90*	*86*

Source: FMSP

4.22 Table 9 shows the change in the proportion of schools and colleges delivering further mathematics in a classroom setting (either timetabled or non-timetabled), as opposed to individual or small numbers of students taking supervised or unsupervised modules. It can be seen that the share of centres offering further mathematics classes increased from 16 out of 21 in 2010 to 24 out of 26 in 2013 before falling back slightly to 21 out of 25 in 2014; that is both the number of centres offering provision increased overall, but the nature of the setting also changed over the pilot period.

Table 9. Further Mathematics Provision in the Pilot Area in 2010 - 2013

	Oct 2010	Feb 2011	Oct 2011	Feb 2012	Nov 2012	Feb 2013	Apr 2014
Schools / Colleges with groups of students in a class (timetabled/ un-timetabled)	16	15	19	21	23	24	21
Schools / Colleges with 1 supervised student per module or up to 2 unsupervised students	5	6	3	4	3	2	4
Total	21	21	22	25	26	26	25

Source: FMSP

Outcome 3: Increased Numbers of Mathematics Teachers in Wales who are Trained to Teach Further Mathematics.

4.23 The interim report set out that data are not available to show the number of teachers in Wales who are qualified to teach further mathematics and so this outcome could not be assessed effectively in the course of the evaluation.

4.24 The only continuous professional development (CPD) for teachers that was originally included in the FMSP were online resources provided through the English website, where teachers are able to access Live Online Professional Development (LOPD) courses, covering a range of topics relating to all modules of further mathematics A/AS Level courses. Since the time of the interim report, the FMSP has begun to prepare a CPD programme, starting with the "Teaching Further Mathematics" course run by MEI. It has also created an online survey, to gauge interest in CPD provision and assess current levels of training.

4.25 Whilst no data is available about further mathematics qualification levels amongst teachers, details about qualification to teach mathematics itself may provide clues as to the importance of mathematics in the curriculum. the proportion of all secondary teachers trained in mathematics and registered with GTCW increased from 1,204 in 2009 to 1469 in March 2014, accounting for 10 per cent of all teachers by that date[21] and second only to the number of English teachers (10.4 per cent of the workforce). The data shows that 76 per cent of those teaching mathematics at secondary level were known to be trained in the subject; the highest for any core subject area. For comparison, 71 per cent of English teachers and 30 per cent of science teachers[22] were in this category. Further, the number of newly qualified mathematics teachers registered with GTCW increased from 70 in 2009 to 84 in 2013, before falling

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21 http://www.gtcw.org.uk/gtcw/images/stories/downloads/Annual%20Statistics%20Digest/Annual_Stats_14_E.pdf. No. of teachers registered by GTCW by ITET Subject trained (secondary only).

22 The lowest proportion of the core subjects. Proportions were higher for individual science subjects, however.

back slightly to 75 in 2014 and accounting for 12 per cent of the total at that time; the largest proportion of any subject specialism apart from English.

Outcome 4: Overall raised awareness among students and their parents of the importance of studying mathematics at higher levels.

Attitudes towards Further Mathematics

4.26 The interim evaluation report highlighted broad agreement amongst stakeholders and students that studying further mathematics was beneficial, both at GCE and in HE, although their most common reasons for engaging in further mathematics were a personal interest in the subject, the benefit in terms of university entry requirements and building future career options.

4.27 School students were especially aware that further mathematics could help them stand out 'from the crowd', and give them a head-start on reaching University. Almost 30 per cent of surveyed students recognised the potential for further mathematics to assist in the transition from AS/A level to undergraduate study.

Outcome 5: Increased numbers of students from Wales applying to study higher education courses in mathematics and related subjects, such as engineering and physics.

4.28 HESA Data was secured from Welsh Government to show the number of first degree students from the pilot region and from Wales as a whole engaged on mathematical science or STEM courses[23] at UK Higher Education Institutions (HEIs). The number of students enrolled on mathematical science courses from the pilot area grew from 50 in 2007-8 to a peak of 80 between 2009/10 and 2010/11 before falling off to 75 in 2012-13. Over the same period, enrolments onto STEM subjects fluctuated from 1,530

[23] This study uses a definition of STEM which includes: Medicine, dentistry and allied subjects, biological and veterinary sciences, agriculture, physical sciences, mathematical sciences, computer science, engineering & technology, architecture, building and planning. A detailed list of this subject appears on the HEFCE website here: http://www.hefce.ac.uk/media/hefce/content/pubs/2014/cl022014/CL2014-02%20Annex%20A.pdf

in 2007/8 to a peak of 1,840 in 2009/10 before falling off to 1,630 in 2012/13.[24]

Table 10. First year, Welsh Domiciled Students Enrolled on Mathematics and Stem Subjects at UK Universities.

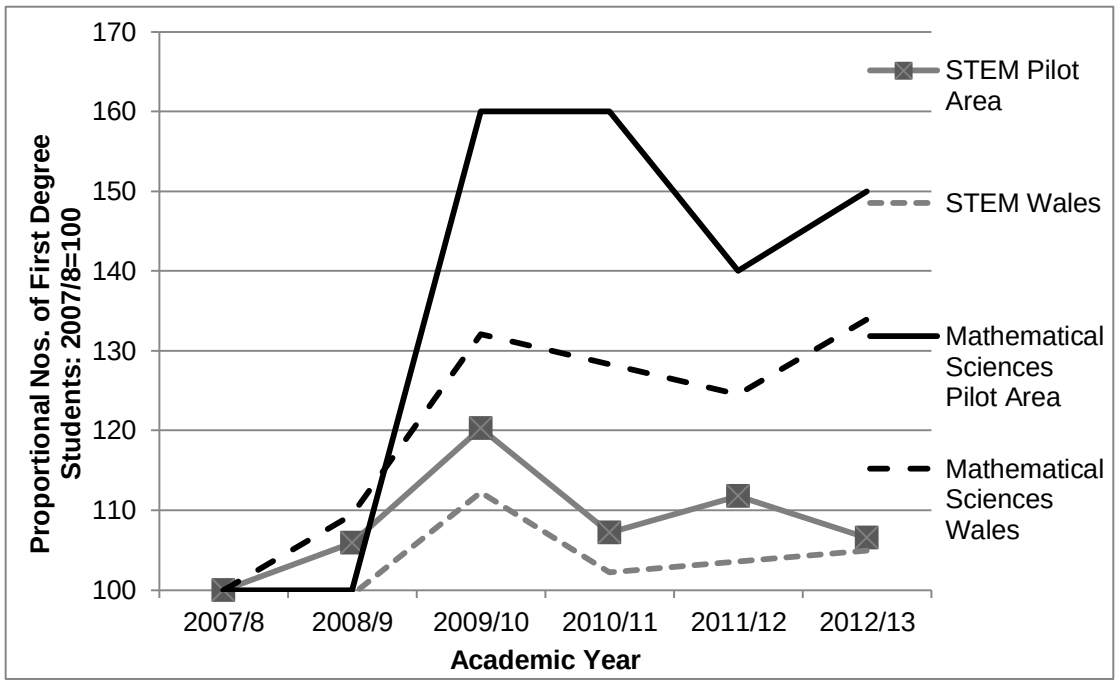
Academic Year		2007/8	2008/9	2009/10	2010/11	2011/12	2012/13
	Pilot Area	1,530	1,620	1,840	1,640	1,710	1,630
STEM	All Wales	7,080	7,035	7,945	7,235	7,335	7,430
	UK	122,665	131,825	139,695	140,660	151,685	144,215
Mathematical Sciences	Pilot Area	50	50	80	80	70	75
	All Wales	265	290	350	340	330	355
	UK	6,055	6,525	6,780	6,845	7,030	6,625

Source: HESA / Welsh Government

4.29 Hence the overall growth in pilot area mathematics students, of 50 per cent, outstripped that of Wales as a whole over the period, for which the figure was 34 per cent, although it can be seen that the increased rate of growth began before the pilot commenced, and the data appears quite volatile. Future data will be necessary to show that the trend of increased growth was sustained, or indeed sustainable.

[24] In the interim evaluation report, figures for Welsh domiciled students in all years of undergraduate degrees were used. This report uses improved data for first year students only, reflecting the changes since the beginning of the pilot more clearly.

Figure 5. First Year, First Degree Students Domiciled in SW Wales / Wales on Mathematical Sciences / STEM Courses in UK HEIs, 2007-2012



Source: Welsh Government / HESA

4.30 The growth in the number of first degree mathematics students from Wales as a whole will reflect the contribution of the pilot area, as well as any increase in student numbers from the rest of Wales. If the pilot area were removed from the Wales figures, the difference between pilot and non-pilot areas would be greater.

4.31 According to UCAS Data[25] there is significant variation by country in the proportion of 18 year olds applying to university across all subjects. In 2014, 47 per cent of 18 year olds from Northern Ireland applied, whilst the figures for England, Scotland and Wales were 35 per cent, 31 per cent and 30 per cent respectively. Although the proportion of Welsh students *enrolling* on mathematics courses[26] as a proportion of all subjects was broadly in line with that of English students, the overall proportion of young people from Wales

[25] Applicant statistics, (interim) May 2014: UCAS Analysis and Research.
[26] 2.10 per cent, England; 2.13 per cent, Wales. HESA, 2014. Whilst data on applications and enrolments is not directly comparable, it is useful to consider the comparable rate of mathematics enrolments from Welsh-domiciled student in the context of the low rate of overall applications.

applying for mathematics subjects still lies below that of young people from England. This was not the case, however, for STEM subject applications.

Table 11. Applications for Mathematics and Stem Subjects at UK Universities from students domiciled in Wales and England

Academic Year		2010	2011	2012	2013	2014
Applications, numbers						
STEM Applications	Wales	37,990	40,710	41,630	41,500	43,540
	England	745,810	805,250	772,670	811,880	863,220
Mathematical Sciences Applications	Wales	1,690	1,560	1,570	1,650	1,550
	England	30,740	31,740	30,070	31,840	31,480
All Subjects	Wales	92,270	96,010	94,580	91,840	94,810
	England	1,966,320	2,043,560	1,841,670	1,886,580	1,958,370
Population of 18 year olds	Wales	40,876	39,797	40,243	37,860	-
	England	682,632	671,694	670,895	650,210	-
Applications as a proportion of 18 year olds, percentages						
STEM Applications	Wales	*93*	*102*	*103*	*110*	-
	England	*92*	*83*	*87*	*80*	-
Mathematical Sciences Applications	Wales	*4.1*	*3.9*	*3.9*	*4.4*	-
	England	*4.5*	*4.7*	*4.5*	*4.9*	-
All Subjects	Wales	*230*	*240*	*240*	*240*	-
	England	*290*	*300*	*270*	*290*	-

Source: UCAS (June 2014 Deadline) / ONS Mid-year Population Estimates for 18 year olds.
Note; Applicants can apply for more than one course and may be ages other than 18.

4.32 There was a 3.2 per cent increase in applications from Welsh-domiciled students to UK universities across all subjects, from 91,840 in 2013 to 94,810 in 2014[27]. This was compared with an increase at UK level of 3.6 per cent (from 2,243,190 applicants to 2,325,060)

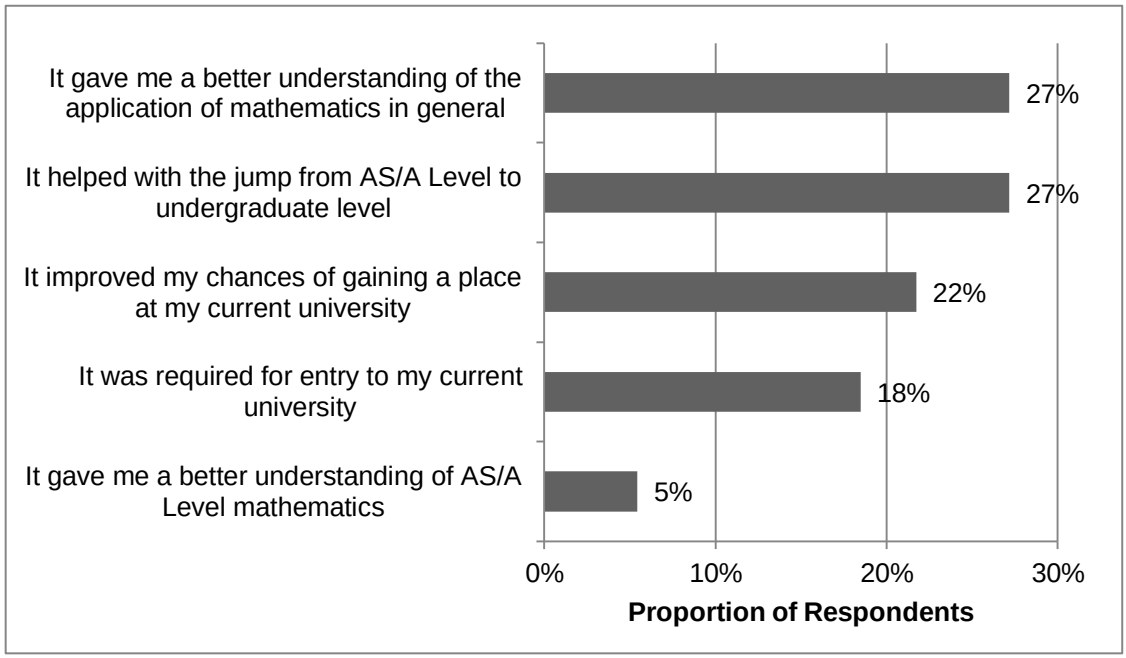
[27] file:///J:/(P-697)%20Evaluation%20of%20the%20FMSP%20Pilot/2014%20Update/june-2014-deadline-analysis-subjects.pdf

Outcome 6: Improved transition of students from further to higher education courses in mathematics, or from courses which have a significant element of mathematics, thus benefiting the wider economy.

4.33 The interim evaluation report noted that there was a general consensus that taking further mathematics at AS/A Level eased the path of transition for students going into mathematics and STEM courses. However, there were very few students or HE lecturers who felt that the difference between those with and those without further mathematics persisted beyond the first year of undergraduate study.

4.34 In the online survey of students that formed part of the research for the process evaluation in 2013, respondents identified help with the transition to undergraduate study as the joint most important advantage of studying further mathematics (27 per cent of responses), along with gaining a better understanding of mathematics in general.

Figure 6. Undergraduate Students: Main Advantage of Studying Further Mathematics A/AS



Source: Online Survey of Students. Base=93. Only single response allowed.

Longer Term Impacts

4.35 In terms of longer-term impacts, there is generic data on graduate destinations, which provides some insights into the relative position of

mathematics and STEM graduates. The data shows that mathematical science graduates are less likely than average to go into employment and more likely than average to continue on to further study, or a combination of work and further study.

Table 12. Destinations of Full-Time First Degree Leavers by Subject Area Six Months After Graduating 2011-12 (Known Destinations)

Percentages	Mathematics	STEM	All Subjects
UK work	*52*	*65*	*63*
Overseas work	*2*	*2*	*3*
Work and further study	*8*	*5*	*6*
Further study	*25*	*15*	*15*
Unemployed	*9*	*8*	*9*
Other	*5*	*4*	*5*
Total percentage	*100*	*100*	*100*

Source: HESA 2013

4.36 In terms of those who entered employment, mathematics graduates were more likely than average to secure careers in professional/associate professional roles (although less likely to become professionals than STEM graduates as a whole).

Table 13. Occupation of Full-Time First Degree Leavers Entering Employment in the UK by Subject Area of Degree 2011-12

Percentages	Mathematics	STEM	All
Managers, directors and senior officials	*3*	*3*	*4*
Professional occupations	*43*	*53*	*34*
Associate professional and technical occupations	*28*	*18*	*26*
Total professional	*74*	*74*	*64*
Administrative and secretarial occupations	*10*	*5*	*9*
Skilled trades occupations	*1*	*1*	*1*
Caring, leisure and other service occupations	*3*	*6*	*7*
Sales and customer service occupations	*8*	*9*	*13*
Process, plant and machine operatives	*0*	*0*	*0*
Elementary occupations	*4*	*5*	*6*
Total non-professional	*25*	*26*	*36*

Source: HESA 2013

4.37 Perhaps the starkest difference in terms of employment profile was in the sector of employment: mathematics graduates were very much more likely than average to be employed in the financial sector, or in the property

development, business and research sector than other graduates and very much less likely to enter health and social work, for example.

Table 14. Industry of Full-Time First Degree Leavers Entering Employment in the UK by Subject Area of Degree 2011-12

Standard Industrial Classification	Mathematics %	STEM %	All %
Agriculture, forestry and fishing	0	0	0
Mining and quarrying	1	1	1
Manufacturing	5	5	4
Electricity, gas and water supply	1	1	1
Construction	1	2	1
Wholesale and retail trade/repair(2)	12	13	17
Hotels and restaurants	4	4	6
Transport, storage and communication	11	7	8
Financial activities	21	4	5
Property development, renting, business and research activities	23	14	17
Public administration and defence/social security	3	3	4
Education	11	8	12
Health and social work	3	33	18
Other community, social and personal service activities	4	4	6
Private households with employed persons	0	0	0
International organisations and bodies	0	0	0

Source: HESA 2013

4.38 With regard to salaries, HESA Statistics show that the average salary for a mathematics graduate after six months of leaving university is £24,437[28], against an average for all graduates of £21,762. Dentistry was the highest earning degree, at £30,681 and all of the twelve highest earning subjects were STEM-related. It should be noted, however, that the setting in which graduates were employed had a significant effect on their salaries.

[28] HESA 2011-12, published May 2014, quoted in http://www.thecompleteuniversityguide.co.uk/ Figures for those in “graduate jobs”.

Value for Money

4.39 Assessing value for money of a pilot programme can be challenging, given the extent of capacity building and initial programme development entailed, in addition to the delivery of support for further mathematics itself. Measures to assess value for money were explored as part of the evaluation, but it was decided that narrow outcome measures such as additional attributable examination outcomes per pound invested did not adequately represent the overall value of the pilot and would be misleading, because for example, it would overlook the additional benefits realised in terms of increased entry levels in Wales outside the pilot area and impacts on increased recruitment onto mathematics courses, or engagement of pre-16 pupils. Within the pilot area, the programme has delivered extensive benefits beyond examination entries, in terms of increased numbers of students studying further mathematics, awareness raising and encouragement of students to undertake mathematics and STEM subjects at a higher level, plus capacity building amongst teachers.