



Department
for Education

Linked pair of GCSEs in mathematics (MLP) evaluation: Final report

Research Report

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1 Executive summary

1.1 Introduction

AlphaPlus Consultancy Ltd was commissioned – originally, in March 2010, by the Qualifications and Curriculum Development Agency (QCDA) and then, from March 2011, by the Department for Education (DfE) – to evaluate the pilot of the linked pair of GCSEs in mathematics (MLP). The pilot programme ran from September 2010 until August 2013. The evaluation was designed to run for nearly four years and to report in January 2014.¹ During that time AlphaPlus carried out six rounds of fieldwork and produced five interim reports, the first of which was published in December 2011.² This final report presents the findings from the six rounds of fieldwork and the analysis of attainment data from the participating awarding organisations³ and national statistics, and provides an overview of the evaluation.

There has been some fluctuation in the number of centres participating in the pilot, with some centres dropping out and others joining. In March 2013 awarding organisations reported that there were 271 centres participating in the pilot: AQA, 97; Pearson (Edexcel), 99; OCR, 65; WJEC, 10. Following the summer examination series, awarding organisations reported 229 centres participating in the pilot: AQA, 92; Pearson (Edexcel), 86; OCR, 40; WJEC, 11. No awarding organisation was allowed to have more than 100 centres involved in the pilot, with the number allowed to WJEC being limited to 12 centres.

1.2 Background to the pilot

The MLP qualifications are ‘methods in mathematics’ and ‘applications of mathematics’. The two qualifications together cover the entire Key Stage (KS) 4 programme of study (PoS) for mathematics and contain some additional content; neither qualification by itself covers the full KS4 PoS. A new single GCSE in mathematics was also developed for first teaching in September 2010. Both the single GCSE and the MLP assess the KS4 PoS, but with the MLP the PoS forms a subset of what is assessed. Candidates were expected to be entered either for the single GCSE in mathematics or for both qualifications of the MLP.

The single GCSE and the pilot qualifications were developed with three aims:

- To increase engagement with and participation in mathematics at GCSE and beyond

¹ The MLP pilot is funded by the Department for Education (DfE) in England and the Welsh Government in Wales.

² ‘The independent evaluation of the pilot of the linked pair of GCSEs in mathematics, first interim report’, DfE, Research Report DFE-RR181.

³ AQA, Edexcel (Pearson), OCR and WJEC.

- To enable understanding of the relevance of mathematics
- To offer opportunities to stretch and challenge all students

There were additional, wider, aims for the MLP, which were:

- To increase students' commitment to, and engagement with, mathematics
- To develop greater breadth and depth of subject skills and knowledge in students, by having them undertake two GCSEs, with additional content, that would prepare them for progression to further study
- To develop students' recognition of, and capacity to use, the different methods of enquiry encouraged by having two distinctive GCSEs

1.2.1 The evaluation focus

The overarching research questions for the evaluation of the MLP have been:

- How were the MLP qualifications being implemented?
- What impact have the MLP qualifications had on the teaching and learning of mathematics (including the impact on students' engagement, and on their skills, knowledge and understanding, in terms of the breadth and depth of their understanding of mathematics)?
- To what extent were the MLP qualifications appropriate for different student cohorts and different centres?
- What impact does the MLP have on students' participation, attainment and progression in mathematics?
- What has been the 'value' of the MLP qualifications over and above what is offered by the single GCSE?

The overall aim of the evaluation was to consider the extent to which the MLP offered a different experience of learning mathematics from the new-specification single GCSE.

1.3 Methodology

The evaluation has collected fieldwork data over the first two and a half years of the pilot and has included visits to case-study pilot centres, pilot-centre online surveys, and stakeholder telephone interviews and focus groups. The evaluation has also included statistical analysis of the assessment data provided by awarding organisations participating in the pilot, matched to the national pupil database (NPD) for England and Wales, and data about schools from Ofsted and Edubase.

This report has used data from all six rounds of fieldwork with case-study centres. Case-study pilot centres were originally identified for the first round of visits conducted in autumn 2010. They were selected to ensure coverage of awarding organisations represented in the

pilot, centre type and region, phase of education (i.e. 11–16 and 11–18), and urban and rural contexts. As far as possible, the same case-study centres have been visited for each phase of fieldwork in order to offer a qualitative longitudinal study of change brought about by the MLP. Fourteen pilot centres took part in the first round of field research. The sample has been refreshed for subsequent rounds as and when necessary, with centres that have left the pilot being replaced with similar centres on a rolling basis. Given the relatively small number of case-study centres, however, caution should be taken when interpreting the findings.

A total of 13 case-study pilot centres were involved in the final round of field research. The new data collected in February and March 2013 consisted of in-depth interviews and observations at eight case-study pilot centres, and in-depth telephone interviews with the head of mathematics (HoM) from five case-study pilot centres. All eight centres in which the interviews and observations were conducted had taken part in at least three previous rounds of data collection, and five of them had been case-study pilot centres since the beginning of the evaluation. The five telephone interviews were conducted with the HoMs of case-study pilot centres that either no longer offered the MLP (and thus could not offer lesson observations) or were not in a position to accommodate a visit at that time. Of these five centres, three had been case-study pilot centres since the beginning of the evaluation and the other two had taken part in the last three rounds of data collection. The centres that were no longer taking part were still interviewed because they were able to offer a valuable insight into any difference, perceived or evidenced, between the MLP and the single GCSE.

Of the 13 case-study pilot centres included in the final round of fieldwork, six centres were offering the MLP qualifications to their whole cohort, three offered the MLP and the single GCSE (joint-offer centres) and four had not offered the MLP to any new students since autumn 2012 – in other words, they were currently offering the single GCSE only.

The analysis and reporting following the final round of fieldwork focused on the learning journey for the schools involved in the pilot in terms of distance travelled and lessons learned. Data collected from the previous rounds of fieldwork were included in the analysis. The key elements of the process for implementation were considered to be:

- centre- and department-level drivers and management of the pilot
- the impact on teaching and learning (including what aspects of the MLP qualifications have had the greatest impact on developing students' mathematical skills and preparing them for further study)
- the support and continuing professional development that staff received.

The focus of the analysis was to recognise the characteristics or features of the learning journey of the centres and how centre context may have affected the perceived value of the MLP. Centre context was defined here in terms of school culture in relation to, for example, performance targets, personalisation of learning, openness to change, and autonomy of the mathematics department. Case-study centres were clustered to reflect similarities in the learning journey and context and are presented in the main report as five multi-site case studies defined as case-study clusters.

Other data sources for this report include interviews with 32 joint-offer pilot centres undertaken in 2012 for the fourth interim report, and the three online surveys of pilot centres. Further details on all the data collected at each phase of the evaluation are included in Appendix 1. There has been no further fieldwork undertaken for the final report.

For the final report, further statistical analysis has been undertaken. Table 1 shows the databases that were used in the 2013 statistical analyses:

Table 1: Statistical analysis undertaken autumn 2013

England	Wales
Data supplied by AQA, Edexcel, OCR and WJEC for all candidates on the MLP and all single GCSE (2012 and 2013 attainment data)	
Awarding organisation lists of MLP participant centres based on communication with centres supplied by AQA, Edexcel, OCR and WJEC	
NPD census (demographic) information about students in MLP and single GCSE	NPD census (demographic) information about students in MLP and single GCSE
NPD KS2 Attainment information about students in MLP and single GCSE	NPD KS2 attainment information about students in MLP and single GCSE (derived from teacher assessment)
School Section 5 inspection grades from Ofsted	Estyn did not supply school inspection data for Welsh schools
School demographic and administrative information from Edubase	Some school demographic information from Edubase (incomplete for Welsh schools) plus information from DfES ⁴ regarding Welsh schools

1.4 Summary of findings and conclusions

How were the MLP qualifications implemented?

Centres proposed a range of models of delivery, categorised in the case study data as:

- sequential – one GCSE being taught first, followed by the second GCSE

⁴ Department for Education and Skills, Welsh Government

- parallel – the two GCSEs being taught alongside each other as distinct subjects
- integrated – the two GCSEs being taught together.

There was some evidence to suggest that, at least initially, the integrated model was in practice business as usual, involving very little change to teaching and learning. Those centres which had opted for this model, however, commonly moved towards a parallel approach as the examinations approached, feeling that this was a better way to prepare students for the different types of question they were likely to meet in the two examinations. Centres that followed a sequential model of delivery throughout, did so on the grounds that students would genuinely get opportunities to achieve a C grade or better only if they had a chance of completing one whole qualification at the end of year 10. Where they had started with Methods, they sought to link the knowledge and understanding developed in year 10 to the skills required for Applications in year 11.

What impact have the MLP qualifications had on the teaching and learning of mathematics?

Data from the case studies indicated that the implementation of the MLP had the greatest impact on teaching and learning in centres in which the focus was on enriching students' experience of learning mathematics and increasing mathematical understanding, rather than on increasing GCSE grade performance.

As was noted in the first interim report, for the opportunities offered by the MLP to be realised, many centres had needed to make considerable changes to their approaches to teaching and learning. How far centres were able to do this depended primarily on the extent to which they embraced a more student-led, challenging and open approach in their teaching. The majority of teachers nevertheless recognised the need to change their teaching approaches and were looking for resources to do this.

To what extent are the MLP qualifications appropriate for different student cohorts and different centres?

Students' engagement and motivation were felt to have increased significantly where new, innovative teaching methods had been prompted by the introduction of the MLP. Opinion remained divided, however, about the suitability of the MLP for the majority of student groups. Overall, case-study centres considered the MLP to be broadly appropriate for most student groups, provided there was enough curriculum time to teach the additional content. Quite how much time the MLP required appeared to depend on factors such as student cohort, centres' mode of delivery and on when assessments were taken.

A relatively large number of centres entered the whole cohort for the MLP pilot, but there remained concerns that the MLP might not be suitable for some lower-attaining students.

The low levels of literacy of these students could result in their struggling to understand what is required when faced with scenario-based/contextualised tasks (there is more of a focus on applications of mathematics in the MLP than the single GCSE). The statistical data, however, showed a large proportion of higher-attaining students entered for the assessments, with many pilot centres reporting that they had used the qualifications to stretch and challenge higher-tier students. Some pilot centres, reluctant to run the risk of students failing to achieve a C grade in mathematics, were unwilling to put C/D grade borderline students in for the pilot qualifications.

Academy converter and community schools were the biggest groups taking single GCSE (more than 200,000 candidates). The numbers of candidates from other establishment types decreased quite rapidly. There was a similar pattern seen for centre participation in the MLP, with the exception of further education colleges. Although further education was the fifth largest group providing single GCSE mathematics, only one further education college – from Wales – took part in the MLP pilot. The college withdrew, however, after entering one small cohort of learners. A small number of FE colleges were interviewed in the early phase of the evaluation. The data collected suggested that the time required for more content and additional assessments may be an issue for adult students. Wider stakeholders interviewed suggested that the emphasis for colleges working with 16–19 year olds was GCSE retakes, so there was less interest in the MLP pilot.

What impact does the MLP have on students' participation, attainment and progression?

Participation was largely determined by centres' perceptions of the value of the MLP and its appropriateness for particular student groups. The statistical analysis shows 839,407 candidates took single GCSE mathematics in 2013, and that 17,447 candidates completed both MLP qualifications in either 2012 or 2013 (i.e. they did either both in 2013, or one in 2012 and one in 2013). This reflects the small-scale nature of the pilot.

The statistical analysis shows that attainment of candidates taking the MLP was higher than that of single GCSE candidates. This is true of Uniform Mark Scale (UMS), mean grade score (on the individual Applications and Methods qualifications) and mean 'best' grade score. Candidates' attainment on the two MLP qualifications was highly comparable and higher on both than on the single GCSE. These findings were also reflected in the case-study data, where centres largely reported improved grades. The exception to this was where centres had made minimal changes to their pedagogy and reported that grades were lower than expected on the MLP. Those centres where the focus was fixed on grade performance often reported limited changes to pedagogy, and were inclined to withdraw from the pilot because students' grades were not as good as they had expected. Because of

the relatively small number of case-study centres, however, caution should be taken when interpreting the findings.

The greater emphasis on application of mathematics and use of mathematical problem-solving skills in the MLP was seen to support students in progressing to A level studies. Two-thirds of the joint-offer centre HoMs interviewed in 2012 who commented on bridging qualifications felt that these were neither necessary nor desirable: they felt that the MLP enriched and expanded students' knowledge in appropriate ways without the undesirable practice (as several HoMs saw it) of 'fast-tracking' them to A level. They argued that students who undertake bridging qualifications are in danger of lacking motivation at AS, as they will already have covered a lot of the ground at that level in their bridging qualifications.

That said, a third of the HoMs interviewed were using or planning to use bridging qualifications.⁵ They thought that these were useful and necessary to stretch and challenge their highest-attaining students, as the MLP was not more difficult than the single GCSE. They welcomed the opportunity that the bridging qualifications offered to deepen students' grasp of the most difficult GCSE topics and provide them with 'a trial run of AS level'. HoMs liked the large amount and depth of algebra and the way in which the bridging qualifications engaged students in calculus and differentiation.

What is the 'value' of the MLP qualifications over and above what is offered by the single GCSE?

Based on the perceptions of pilot centres offering the MLP and the single GCSE, the following statements can be made:

- The MLP was thought to provide more stretch and challenge to higher-attaining students than the single GCSE.
- Because of its additional topics, greater emphasis on application of mathematics, use of mathematical problem-solving skills and, to some extent, because students found it more engaging, the MLP was also seen to provide a better foundation for A level studies than the single GCSE, and thus to aid progression.
- The three topics that were cited as most useful in stretching and challenging students and supporting progression in the MLP were algebra, pre-calculus (area under a curve) and linear programming.

⁵ DfE 'The independent evaluation of the pilot of the linked pair of GCSEs in mathematics (MLP), fourth interim report', London: DfE.

- A large majority thought that the MLP encouraged a broader understanding of mathematics than the single GCSE, with the four most valued topics in the MLP being finance, linear programming, Venn diagrams and set theory. Two of the reasons cited for the popularity of these topics were that they offered a good preparation for A level and that they were areas of mathematics that students saw as having the greatest relevance.
- Although a smaller majority held the view that the MLP encouraged deeper mathematical understanding than the single GCSE, those who did cited the breadth of topics (which allowed more connections to be made), greater opportunities for practising problem-solving skills, more opportunities to apply mathematics, and an opportunity to introduce pre-calculus work.

Conclusions

The evaluation has emphasised the different learning journeys for case-study centres. Common to most, however, is the need for time – time to implement change effectively within a centre, but also time in the classroom to allow for a more dialogic, interactive approach to teaching and learning that supports the development of reasoning and problem-solving skills.

There needs to be more emphasis on the different types of problem solving and the different learning that results from them. The MLP pilot has led to some effective collaboration between awarding organisations in an attempt to understand more clearly how to develop questions to assess problem solving. The pilot phase has seen some progress in the teaching of problem solving, but some teachers would like further support. Centres have continued to focus on ‘problem solving’ in terms of generic skills, where problems are presented as words with arithmetical steps or worded contexts that require the student to decide to use standard techniques. Findings from the fieldwork suggest that there has been less focus on problem solving in terms of mathematical ways of thinking.

One of the most positive messages to emerge from the pilot, however, was that with some centres there was a strong sense that teachers would not be returning to their old – and less engaging – pedagogic approaches in the future, even were the MLP or similar qualifications no longer to be available.

2 Introduction to the final report

2.1 Background to the pilot and the evaluation

AlphaPlus Consultancy Ltd was commissioned – originally, in March 2010, by the Qualifications and Curriculum Development Agency (QCDA) and then, from March 2011, by the Department for Education (DfE) – to evaluate the pilot of the linked pair of GCSEs in mathematics (MLP). The pilot programme ran from September 2010 until August 2013. The evaluation was designed to run for nearly four years and to report in January 2014.⁶ During that time AlphaPlus carried out six rounds of fieldwork and produced five interim reports, the first of which was published in December 2011.⁷ This final report presents the findings from the six rounds of fieldwork and the analysis of attainment data from the participating awarding organisations⁸ and national statistics, and provides an overview of the project.

There has been some fluctuation in the number of centres participating in the pilot, with some centres dropping out and others joining. In March 2013 awarding organisations reported that there were 271 centres participating in the pilot, as follows: AQA, 97; Pearson (Edexcel), 99; OCR, 65; WJEC, 10. Following the summer examination series, awarding organisations reported 229 centres participating in the pilot: AQA, 92; Pearson (Edexcel), 86; OCR, 40; WJEC, 11. No awarding organisation was allowed to have more than 100 centres involved in the pilot, with the number allowed to WJEC being limited to 12 centres,

2.1.1 Context: background and policy change

Adrian Smith's 2004 report, *Making Mathematics Count*, was highly critical of 'the failure of the current curriculum and qualifications framework to meet the requirements of learners, higher education and employers, and to ensure that sufficient numbers of young people continue with mathematics post-16'.⁹ Part of his report's response to such concerns was the recommendation that serious consideration should be given to making a double award available for GCSE mathematics, to bring mathematics into line with double awards in English and science.¹⁰ The origins of the MLP, therefore, lie in the Smith report.

⁶ The MLP pilot is funded by the Department for Education (DfE) in England and the Welsh Government in Wales.

⁷ 'The independent evaluation of the pilot of the linked pair of GCSEs in mathematics, first interim report', DfE, Research Report DFE-RR181.

⁸ AQA, Edexcel (Pearson), OCR and WJEC.

⁹ DfES (2004) *Making Mathematics Count: The Report of Professor Adrian Smith's Inquiry into Post-14 Mathematics Education*, para 0.36.

¹⁰ *Ibid*, para 4.13.

The QCDA, with the close involvement of the Advisory Committee on Mathematics Education (ACME), developed the original proposal, and the pilot began in September 2010. The MLP, the development of a new programme of study (PoS) for mathematics, placed renewed emphasis on problem solving, functionality and mathematical thinking. Alongside the pilot of the MLP, new subject criteria and a new-specification single GCSE in mathematics were developed for first teaching from September 2010.

The MLP qualifications are 'methods in mathematics' and 'applications of mathematics'. The two qualifications together cover the entire Key Stage (KS) 4 programme of study (PoS) for mathematics and also contain some additional content. Neither qualification by itself covers the full KS4 PoS; each qualification in the MLP is intended to have a distinctive quality. This is so that students might be explicitly aware of the skills they are developing and the topics covered – and of the relationship of these skills and topics to problem solving in everyday life, mathematical conceptualisation and critical thinking.

The applications of mathematics GCSE was intended:

To assess skills relating to how mathematics is used to interpret, analyse and solve problems relating to a range of realistic contexts, including financial and statistical applications; place an additional emphasis on the interpretation of graphical information and the use of approximate methods.

The methods in mathematics GCSE was intended:

To assess powers of reasoning and logical deduction; assess fluent use of symbolisation and exact methods of solution; assess understanding of probability.

A new single GCSE in mathematics was also developed for first teaching in September 2010. Both the single GCSE and the MLP assess the KS4 PoS, but with the MLP the PoS forms a subset of what is assessed. Candidates were expected to be entered either for the single GCSE in mathematics or for both qualifications of the MLP. For the duration of the pilot, a C grade or above in either of these qualifications counted on a par with a C grade or above in the single GCSE in mathematics.

Since summer 2009, following the removal of assessment by coursework, assessment of mathematics has been wholly through timed written examination, and since September 2010 the assessment objectives (AOs) for both the MLP and the new single GCSE are no longer

set out largely in terms of subject content. Instead, they are set out as mathematical skills¹¹ that use the subject content; in the MLP these are weighted differently across the two GCSEs.¹² Unlike the legacy modular GCSEs, in which mathematics was split by topic, each of the linked pair of GCSEs is unitised, with the subject content distributed across units. Assessment was unitised to allow pilot centres a greater degree of flexibility than a linear-only regime.

The single GCSE and the pilot qualifications were developed with three major aims:

- To increase engagement with and participation in mathematics at GCSE and beyond
- To enable understanding of the relevance of mathematics
- To offer opportunities to stretch and challenge all students

The additional, wider, aims for the MLP were:

- To increase students' commitment to, and engagement with, mathematics
- To develop greater breadth and depth of subject skills and knowledge in students, by having them undertake two GCSEs, with additional content, that would prepare them for progression to further study
- To develop students' recognition of, and capacity to use, the different methods of enquiry encouraged by having two distinctive GCSEs

As noted in a paper commissioned by QCDA, the two qualifications, although they were distinctive, were also intended to be mutually supportive:

The pilot ... presents a timely opportunity to reconsider how we support students in developing skills in mathematical literacy, modelling and applications that can empower them to make sense of the world in which we live. This requires an approach to curriculum planning that considers how to bridge from the world of mathematics to reality and vice versa not only in the specific GCSE Applications of Mathematics but, as is explored here, in developing mathematical understanding across both GCSEs. It is

¹¹ AO1: recall and use knowledge of prescribed content; AO2: select and apply mathematical methods in a range of contexts; AO3: interpret and analyse problems and generate strategies to solve them. For the MLP, AO3 is different for methods in mathematics: interpret and analyse problems and use mathematical reasoning to solve them (methods in mathematics). AOs for the single GCSE are the same as applications of mathematics.

¹²

	AO1	AO2	AO3
Methods in mathematics	50–60%	15–25%	20–30%
Applications of mathematics	40–50%	30–40%	15–25%
Single GCSE mathematics	45–55%	25–35%	15–25%

*suggested that Applications of Mathematics and Methods in Mathematics should be seen as being mutually supportive and considered jointly so that students have a coherent mathematical experience to inform their study of mathematics as well as to make critical sense of the world in which they live.*¹³

The MLP has been piloted and evaluated during a period of intense focus on the National Curriculum and qualifications at KS4 in England. Changes to government policy – including the aborted proposal to introduce English Baccalaureate Certificates (EBCs) – and consultation on the National Curriculum and GCSEs led to uncertainty about the future of the MLP. In addition, a change in government policy meant that, for students starting the MLP in England from September 2012, the qualifications became 100% terminally assessed. The uncertain future of the pilot qualifications, together with late decisions to extend the availability of the qualifications and changes to assessment, led centres to behave in a range of ways: some withdrew from the pilot or decided not to enter any further cohorts, some entered students for the single GCSE in mathematics as well as the MLP assessments, some entered students for both papers for one qualification at the end of year 10 (rather than using an integrated approach), while others entered fewer students for the pilot qualifications. The findings from the evaluation need to be considered within this context. Nevertheless, the fact that the number of participating centres did not markedly decrease may be seen as a reflection of the perceived value of the MLP.

2.1.2 Focus and format of the report

The overarching research questions for the evaluation of the MLP have been:

- How were the MLP qualifications being implemented?
- What impact have the MLP qualifications had on the teaching and learning of mathematics (including the impact on students' engagement, and on their skills, knowledge and understanding, in terms of the breadth and depth of their understanding of mathematics)?
- To what extent were the MLP qualifications appropriate for different student cohorts and different centres?
- What impact does the MLP have on students' participation, attainment and progression?

¹³ Wake, G (nd) 'Connecting mathematics with reality: connecting reality with mathematics', Geoff Wake, London: Qualifications and Curriculum Development Agency. This was one of a number of think-pieces commissioned to support teachers implementing the MLP.

- What has been the 'value' of the MLP qualifications over and above what is offered by the single GCSE?

The overall aim of the evaluation was to consider the extent to which the MLP offered a different experience of learning mathematics from the new-specification single GCSE introduced in 2010. Subject content and assessment objectives have now been published for a new GCSE mathematics for first teaching from September 2015. This final report therefore revisits the research questions but, given the current policy context for GCSE mathematics, also considers what can be learned from the implementation of the MLP pilot in terms of the experience and outcomes for centres and students undertaking new qualifications.

2.1.3 The scope and limitations for the report

MLP candidates are not a sub-set of the larger group of single GCSE candidates; they are a different group of people entirely. For this reason, the characteristics of MLP candidates and single GCSE candidates are compared in the statistical analysis, but we do not consider it meaningful to discuss the extent to which MLP candidates are representative of the population of single GCSE candidates.

The statistical analysis undertaken in autumn 2012 for the fourth interim report showed that the majority of centres were following a parallel model of delivery. It has not been possible to undertake similar analysis this time because the move to 100% terminal assessment means that it is less likely that centres following the parallel or integrated model from September 2012 will have had their year 10 students taking assessments in 2013.

When responsibility for the evaluation of the MLP was transferred from QCDA to DfE, there was a change in focus for the evaluation, with analysis such as the scrutiny of examination papers and student perspectives on their experience of the MLP no longer a priority. There is therefore no independent analysis of examination papers or collection of student feedback reported since the first interim report in spring 2011. The content of examination papers and students' perceptions of the MLP have instead been reported from the perspective of other stakeholders.

3 Methodology

The study has collected and analysed both quantitative and qualitative data. The evaluation has collected fieldwork data over the first two and a half years of the pilot and has included visits to case-study pilot centres, pilot-centre online surveys, and stakeholder telephone interviews and focus groups. The evaluation has also included statistical analysis of the assessment data provided by awarding organisations participating in the pilot, matched to the NPD for England and Wales, and data about schools from Ofsted and Edubase. Appendix 1 outlines the data collected and analysed for the previous reports. A technical report on the analysis of the 2012 and 2013 assessment data is included as a separate annex.

During the course of the project two approaches have been adopted towards the analysis and presentation of data. Initially, the analysis and reporting focused specifically on addressing the five research questions. For the fifth interim report, however, the case-study pilot centre visits and telephone interviews with the heads of mathematics (HoMs) focused on the learning journey for the schools involved, in terms of distance travelled and lessons learned. It was considered important at this phase of the evaluation to reflect on the change process, including the process for the implementation of the pilot qualifications. The centre- and department-level drivers and management of the pilot, the impact on teaching and learning (including what aspects of the MLP qualifications had the greatest impact on developing students' mathematical skills and preparing them for further study) and the support and continuing professional development of staff were considered as key elements of the process for the implementation of the pilot.

The focus of the analysis was to identify the main elements of the learning journey undertaken by the centres and the extent to which centre context had affected the perceived value of the MLP. Centre context was defined in terms of influencing factors such as school ethos, the weight given to performance targets, strategies directed towards the personalisation of learning, openness to change, and the degree of autonomy allowed to the mathematics department. Case-study centres were clustered to reflect similarities in the learning journey and in the context, and are presented as five multi-site case studies.

The analysis also drew on data collected from the case-study centres across the previous rounds of fieldwork. Case-study pilot centres were originally identified for the first round of visits conducted in autumn 2010. They were selected to ensure coverage of awarding organisations represented in the pilot, centre type and region, phase of education (i.e. 11–16 and 11–18), and urban and rural contexts. As far as possible, the same case-study centres have been visited for each phase of fieldwork in order to offer a qualitative longitudinal study

of change brought about by the MLP. Fourteen pilot centres took part in the first round of field research. The sample has been refreshed for subsequent rounds as and when necessary, with centres that have left the pilot being replaced with similar centres on a rolling basis. Given the relatively small number of case-study centres, however, caution should be taken when interpreting the findings.

A total of 13 case-study pilot centres were involved in the final round of field research. The new data collected in February and March 2013 consisted of in-depth interviews and observations at eight case-study pilot centres, and in-depth telephone interviews with the HoM from five case-study pilot centres. All eight centres in which the interviews and observations were conducted had taken part in at least three previous rounds of data collection, and five of them had been case-study pilot centres since the beginning of the evaluation. The five telephone interviews were conducted with the HoMs of case-study pilot centres that either no longer offered the MLP (and thus could not offer lesson observations) or were not in a position to accommodate a visit at this time. Of these five centres, three had been case-study pilot centres since the beginning of the evaluation; the other two had taken part in the last three rounds of data collection. The centres that were no longer taking part were still interviewed because they were able to offer a valuable insight into any difference, perceived or evidenced, between the MLP and the single GCSE.

Of the 13 case-study pilot centres included in the final round of fieldwork, six centres offered the MLP qualifications to their whole cohort, three offered the MLP and the single GCSE (joint-offer centres) and four had not offered the MLP to any new students since autumn 2012 – in other words, they were currently offering the single GCSE only.

The key elements of the process for implementation were considered to be:

- centre- and department-level drivers and management of the pilot
- the impact on teaching and learning (including what aspects of the MLP qualifications have had the greatest impact on developing students' mathematical skills and preparing them for further study)
- the support and continuing professional development staff received.

Other data sources for this report include interviews with 32 joint-offer pilot centres undertaken in 2012 for the fourth interim report, and the three online surveys of pilot centres. Further details on all the data collected at each phase of the evaluation are included in Appendix 1. There has been no further fieldwork undertaken for the final report.

For the final report further statistical analysis has been undertaken. Table 2 shows the databases that were used in the 2013 statistical analyses:

Table 2: Statistical analysis undertaken autumn 2013

England	Wales
Data supplied by AQA, Edexcel, OCR and WJEC for all candidates on the MLP and all single GCSE (2012 and 2013 attainment data)	
Awarding organisation lists of MLP participant centres based on communication with centres supplied by AQA, Edexcel, OCR and WJEC	
NPD census (demographic) information about students in MLP and single GCSE	NPD census (demographic) information about students in MLP and single GCSE
NPD KS2 Attainment information about students in MLP and single GCSE	NPD KS2 attainment information about students in MLP and single GCSE (derived from teacher assessment)
School Section 5 inspection grades from Ofsted	Estyn did not supply school inspection data for Welsh schools.
School demographic and administrative information from Edubase	Some school demographic information from Edubase (which is incomplete for Welsh schools) plus information from DfES ¹⁴ regarding Welsh schools

¹⁴ Department for Education and Skills, Welsh Government

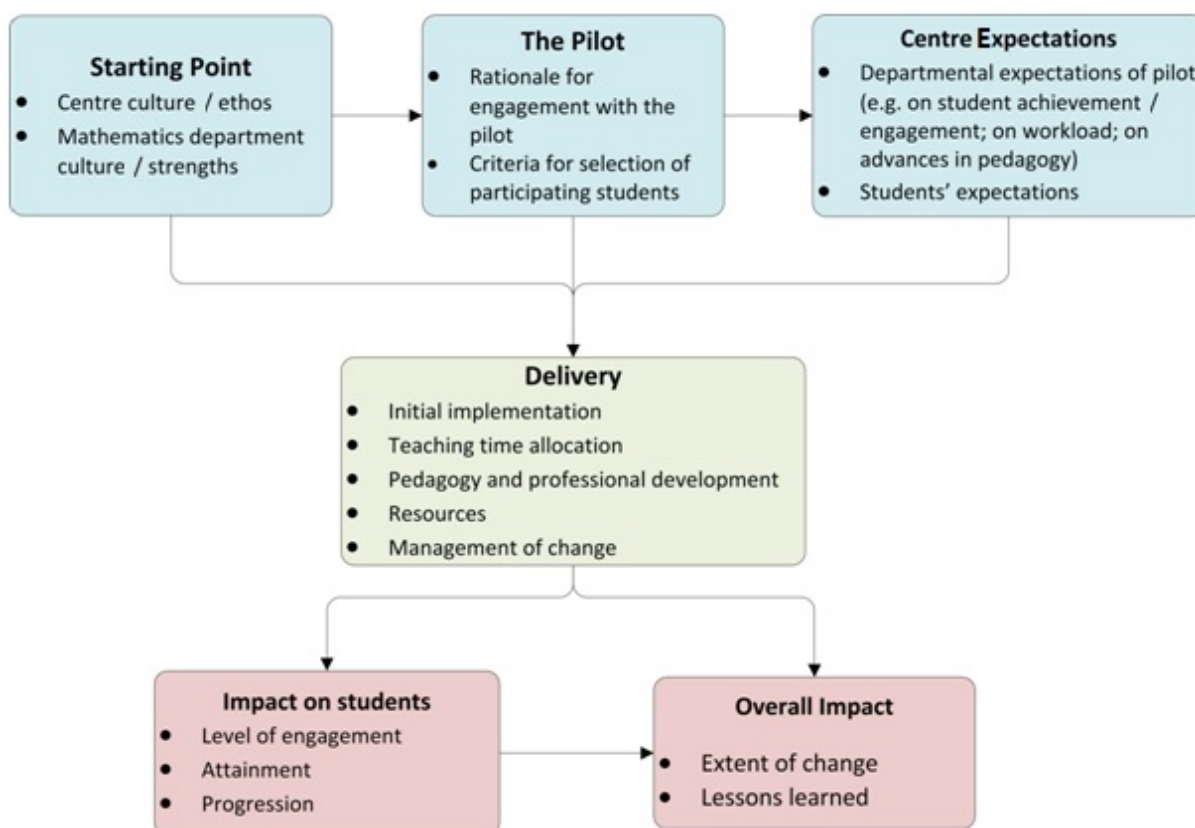
4 Learning journeys

The extent to which the centres changed their approaches to teaching and learning, their perceptions of the value of the MLP and the impact this had upon their students were largely determined by where they had been when they started and their reasons for taking part in the pilot. Considered over the lifetime of the pilot, the data suggests that for the most part the qualifications themselves were broadly used as a vehicle to facilitate change rather than as a catalyst for it. The introduction of the MLP qualifications and any measurement of their impact must therefore be understood within the context of a centre's culture and ethos, and of their reasons for taking part in the pilot.

In order to explore these varying contexts more fully, the findings from the case-study centres were considered as five case-study clusters. A case-study cluster consisted of centres where the approach to, and/or perceptions of the value of, the MLP were similar.

Figure 1 below presents, in diagrammatic form, the criteria that were used to identify these clusters.

Figure 1: Case-study cluster criteria



4.1 Case-study cluster 1

Characterised by a focus on **enrichment** of students' mathematical experience

4.1.1 Starting point

- These three schools were high-achieving schools with an ethos of embracing change, and of being keen to try new things and participate in the development of new qualifications.
- Increased student engagement in mathematics was the key influencing factor for decision making in relation to the pilot, as student attainment at GCSE and the number of students progressing to A level mathematics were already high.
- Willingness to take risks: these schools had a whole-cohort approach from the start, although one school moved struggling foundation-tier students to the single GCSE later.
- Changes to pedagogic approaches prompted by the MLP included change from teacher to facilitator and increase in investigative work.
- Centres expected that students' engagement with mathematics would increase because students would see the relevance of mathematics more readily or clearly.
- They expected that students would be stretched and challenged and their skills would be extended, although attainment in relation to GCSE grades, already high, was not expected to increase.
- It was also expected that the MLP would not only prompt some changes in pedagogy at GCSE level but also affect teaching lower down the school as students were prepared for the new approaches needed.

These centres had also envisaged that the MLP would be a sufficient preparation for students progressing to A level mathematics. In the event, the centres felt that, although the MLP was a better bridge than the single GCSE, they nevertheless had to offer a Level 3 FSMQ in Additional Mathematics to their top sets.

4.1.2 Delivery

- An integrated approach to teaching the MLP was used: topics were taught and then applied. Some more specific teaching of Methods or Applications preceded the examinations, so that students were prepared for the type of questions they would be likely to meet.
- The teaching time available for mathematics teaching at the three schools varied (between three and four hours per week). None of the schools felt strongly that the MLP required more time than the single GCSE.

- Initial schemes of work were revised as teachers' understanding of the MLP developed. Resources were a problem initially and teachers felt the need for more practice questions and teaching materials. They were enthusiastic about the new textbooks and online resources provided by the awarding organisations once they became available, commenting that they made delivery easier. The availability of detailed feedback from the examinations was appreciated, and teachers used this information extensively.
- Professional development took place through normal team meetings, with no extra training being needed. The HoMs attended the sessions provided by the awarding organisations and disseminated information to the department.
- There were changes to pedagogy during the pilot, which teachers felt were often prompted by the requirements of the MLP. Some felt the major change was in the substance of what they taught rather than the methods they used, but others began to take more time to explore students' questions and shifted their role towards that of a facilitator rather than a teacher. Students were encouraged to offer their own solutions to the class and correct each other rather than have teachers intervene and explain the errors themselves.
- The Applications syllabus prompted a change in teaching because links and applications to everyday life needed to feature more in lessons. With the integrated approach, teachers normally taught by topic but incorporated application questions and less-structured problems once students had understood the basic processes.
- Some teachers responded to the greater emphasis on problem solving in the MLP by encouraging more-critical thinking by students. They often focused on asking questions about how students would tackle tasks and why certain methods would work to encourage deeper thinking.
- Teachers also felt they needed to promote more independent thinking by using an exploratory 'try and see' approach and less intervention. These teaching strategies seemed to work well with higher-attaining students, but lower-attaining students were felt to lack the confidence that working in a less-structured way required.
- The departments felt the need to introduce more investigative work into year 9 and to place more emphasis on the application of mathematics lower down the school in order to prepare students for the MLP.
- Teachers found that the MLP allowed them to stretch and challenge the top sets – up to a point – and that some topics (e.g. linear programming) were particularly useful for higher-level students. Lower-attaining students were easily confused by large amounts of information and needed more support to interpret and unpick what was required of tasks when these were presented as scenarios.

4.1.3 Impact on students

- Students appreciated the opportunity to gain two GCSE qualifications in mathematics, and teachers agreed that the extra content was worth an additional GCSE.
- Some of the additional content – such as Venn diagrams, spreadsheets and financial mathematics – was welcomed by teachers. The financial mathematics was felt to be important and students appeared to enjoy the financial applications since they could see the point of mathematics more clearly when it related to real life. There was a view that encouraging students to think about mathematical processes and extending this into applications enabled a more rounded view of mathematics and its use.
- Teachers felt that lower-attaining students benefited from Applications, despite struggling somewhat with the questions, and that they gained some confidence as the course progressed.
- The department that withdrew foundation-tier students from the pilot still held the view that, with more teaching time and earlier preparation for the Applications lower down the schools, the MLP might be appropriate for all students.
- Overall, the content of the MLP lived up to expectations, and the emphasis on the purpose of mathematics was appreciated by staff. There was a feeling that students gained a deeper understanding of concepts in order to apply them and that they benefited from the problem-solving aspects of the course, which challenged them to think ‘outside the box’.
- The need to interpret questions, think them through, make choices and communicate was seen as a valuable aspect of the course. Reactions to the ‘wordy’ questions, however, varied: some lower-attaining students found these difficult to access, while others liked the application to more tangible situations.
- At two of the three centres, attainment had gone up for the middle- and higher-attaining students. The number of A*–C grades was thought to have gone up because the students had a second chance to improve their grade by one grade generally: a student who might have achieved a C grade on the single GCSE might well get a B in one of the MLP qualifications.
- The attainment of students at the third centre was thought to show no significant difference from that of previous years, although actual figures were not available.
- Among the middle- to higher-attaining students the MLP was felt to have made some difference in terms of their achievement or motivation to continue because students had had an opportunity to cover some A level content and more-complicated materials than they would have done in the single GCSE. The MLP was felt to

provide a better challenge for the top sets than the single GCSE, and to promote some deeper thinking that was useful preparation for more advanced study.

- At one of the three centres, the number of A level students did increase during the pilot but it was unclear whether this was as a result of internal progression or applications from other schools.

4.1.4 Overall impact and lessons learned

- The MLP pilot prompted some changes in pedagogy, but other influences also contributed – such as the readiness of the departments to embrace change, the school ethos and the drive for continuous improvement.
- Some teachers initially preferred not to try new approaches but to retain their existing ‘safe’ approaches to teaching the course, since these could be relied upon to produce results. Eventually there was a shift towards applying some different methods.
- Most of the changes in pedagogy were expected to continue beyond the MLP, although one department’s involvement in the Additional Mathematics pilot had already led them to adopt some of the appropriate approaches before the MLP. The mathematics staff at this centre had found the new topics less of a problem to teach than initially anticipated and wanted to retain the financial section even if they did not deliver the entire MLP course in the future.
- The HoMs at two centres expressed a commitment to continuing to place emphasis on problem solving and to encourage more independent and critical thinking, whether or not the MLP was available in the future.
- All three centres had introduced more investigative work into year 9 and placed more emphasis on the application of mathematics lower down the school. These developments, prompted by the MLP, were there to stay. The staff shared the view that it was important to teach students how to apply and use mathematics rather than just to teach content.
- A significant amount of time was needed to prepare resources and search for appropriate materials, even when these were available on websites. New resources were needed earlier in the pilot both for the additional topics and for the new approaches that questions required, particularly for the Applications qualification.

4.2 Case-study cluster 2

Characterised by a focus on students' **engagement** with mathematics

4.2.1 Starting point

- These three schools were high- to mid-achieving schools in which mathematics was an important subject. Participation in the MLP pilot was intended to increase student motivation and the number of A*–C grades.
- The focus for these schools was on enrichment rather than acceleration in terms of students' learning and the need to supplement the learning of their top students.
- The schools allowed time for students to mature – using an integrated approach to teaching and putting students in for final assessments in year 11 only – with good results across the ability range.
- Sustainable changes in pedagogy were prompted by the pilot but also part of the on-going drive for improvement.
- The mathematics departments' involvement in other pilots previously meant they were keen to take part in new developments and confident in their delivery and ability to achieve good results at GCSE level across the ability range.
- Given the positive approach to change and the on-going drive for improvement embedded in the culture, teaching staff adapted well, were ready to engage with new ideas and had the confidence that arises from a legacy of success.
- The mathematics departments' belief that there would be benefits for all abilities led to the entire cohort of students being entered for the MLP throughout the pilot.
- The number of pupils achieving five GCSEs at grade A*–C was a high priority for the schools, so the possibility of students gaining a second GCSE in mathematics was valued as it potentially contributed towards this target.
- The centres expected that the content of the MLP would generate interest and emphasise the relevance of mathematics by offering more opportunities for the application of mathematics than the single GCSE, leading to an increase in the motivation of students across the ability range.
- Centres also hoped to get better results in terms of the number of A*–C grades because of the two chances borderline students would get to achieve a C. Underlying this expectation was a perception that the skills and knowledge needed for Applications and Methods would be different and some students would be better suited to one of the examinations than the other and would therefore achieve a higher grade on one of the two examinations.

4.2.2 Delivery

- The centres used an integrated model of delivery in which the two qualifications were taught as simply 'mathematics' until the examinations drew near – at which point, the distinctions were made clear and students were prepared for the different types of question on the two examinations. This approach was based on the perception that the topics did not need to be separated out, because they were similar, but that the assessments were different in their approach.
- The time allocation, at three hours a week for years 10 and 11, was as it had been previously. This proved to be a challenge for two of the three schools, where the teachers considered that more time was needed to deliver the additional content effectively. In response, they began to teach the GCSE course from May in year 9 so that the GCSE course was then spread over seven terms rather than six. After the first year, one school, feeling there was still insufficient time to teach the course comfortably, brought the start even further forward.
- Lunchtime revision sessions and clinics were also used to provide extra support for students, particularly in the period near the examinations.
- At all three schools, the timing of the external assessments and the relative merits of taking modules early or later were discussed and explored for different groups of students during the pilot. Some teachers felt that early modules provided a useful reality check for students and could increase their motivation to improve; others saw more benefit in the increased maturity and deeper understanding that comes with time. Some teachers felt that 100 per cent terminal assessment was appropriate for those progressing to A level since they would soon need the mathematical knowledge again, although they acknowledged that lower-attaining students coped better with the more manageable chunks of revision required for modular examinations.
- The mathematics departments strongly believed that students' experience of mathematics should be enriched rather than accelerated and that interest should be stimulated that would encourage students to continue with the subject. This belief contributed to departments' choosing an integrated approach to teaching rather than a sequential one.
- Resources for the additional topics in the MLP were sometimes difficult to locate, and it took time to look for them.
- There were steady changes to pedagogy during the pilot, as teachers became more familiar with the emphasis of the course and the assessments.

- The pilot prompted teachers to reflect more on the purpose and use of mathematics and there was, over time, increased use of mathematics in context and the application of mathematics in lessons.
- The problem-solving aspects of the course prompted some teachers to consider suitable methods for developing those skills and to use more questions that promoted deeper thinking and discussion. Some teachers shifted their teaching away from didactic methods and used more small-group work and peer discussion to facilitate the type of thinking and enquiry required by the specifications.
- New lessons and materials were developed for those topics which had additional content that several teachers had not taught before.

4.2.3 Impact on students

- The GCSE results improved across all ability levels during the pilot, partly as a direct result of students' having two chances to achieve a GCSE in mathematics. At two centres, there was an approximately 2% gain in achievement in GCSE mathematics as a result of students gaining a grade C or above in either Applications or Methods, but not in both.
- At two centres, there was an increase in progression to A level (some of which was not directly due to the pilot) and evidence of students being more keen and confident to take A level mathematics – this was attributed to the fact that students' broader experience and wider knowledge of mathematics had increased their confidence in their ability.
- Teachers found that certain aspects of the MLP, such as the promotion of deeper thinking about processes in the Applications questions, provided useful stepping-stones to A level, and considered the MLP a better preparation for A level than the single GCSE – but with reservations. It was felt to be inadequate in, for example, the amount of trigonometry and geometry content and the opportunity to achieve fluency with basic routine manipulation of algebra. As a consequence, a bridging course was designed internally because this was thought to best provide the specific skills and knowledge needed as a foundation for A level study in mathematics. Students were motivated by some of the additional content, and higher-attaining students were particularly engaged by the puzzles and the connections that were made between topics – for example, the use of Venn diagrams with probability.
- The problem-solving aspects were less popular with lower-attaining students who sometimes struggled with 'wordy' questions and failed to understand what mathematics was required.

- The use of contextualised examples appealed to some students who could see the purpose of the applications, and teachers particularly liked the finance section because it related to situations students would meet in their future lives.
- Higher-attaining students expressed positive views about the prospect of gaining two GCSEs in mathematics, and teachers reported an increase in the motivation of lower-attaining students as a result of having two chances to gain a GCSE in mathematics.

4.2.4 Overall impact and lessons learned

- Teachers remained enthusiastic and felt the qualification had broadly met their expectations of increasing the motivation and interest of students and improving their overall results.
- There had been changes in pedagogy as a result of the MLP pilot and the centres' on-going drive for improvement, which would be sustainable and beneficial to students.

4.3 Case-study cluster 3

Characterised by a focus on the **acceleration of middle-attainers**

4.3.1 Starting point

- The two schools making up this cluster were different in type, size and the age group catered for, but their mathematics departments had one decisive factor in common: both had HoMs with strong leadership and vision.
- Both schools had a mixed-ability intake, with few high-attaining students, and thus low progression rates.
- In each school, the opportunity to raise the level of attainment of large numbers of middle-attainers was a key driver.
- There was an interest in major, lasting changes in pedagogy to make mathematics learning more fun and to gradually build students' confidence and ability to tackle any 'problem'.
- The schools had very successfully 'used' the opportunity to have students take assessments one at a time and complete one qualification by the end of year 10 as a way of motivating students and driving up attainment.
- This success was helped by school-level interventions, including introducing functional mathematics and targeting literacy issues lower down the school, and improving the tracking of student progress.
- In both schools, the reason for students' staying on was an appreciation of the clear benefits to them beyond an increase in attainment. The two schools have traditionally

had a relatively low number of students progressing to A level mathematics and other mathematics-related qualifications at level 3.

- At neither school had the mathematics department traditionally been particularly strong, although this was considered to be due more to the nature of the student cohort than to the teaching and learning. Both departments usually had a full cohort of qualified staff.
- The initial, and by far the most important, reason for the mathematics departments to enrol in the pilot was to give their large numbers of middle-attaining students two opportunities to get a C grade or better in mathematics. As a result, the key success measure initially was whether MLP students' attainment had increased. As the staff started seeing benefits of the MLP in terms of a noticeable increase in students' level of engagement and mathematical understanding, however, the importance given to attainment measured in grades reduced.
- A secondary reason for taking part in the pilot was to stretch the schools' relatively few higher-attaining students.
- A third consideration when choosing to join the pilot was that the MLP was thought to offer a greater range of topics and therefore a greater breadth of mathematics than the single GCSE.
- The HoMs saw an opportunity to build in an incentive structure for middle-attaining (C/B and D/C borderline) students: if they achieved a C when entered for Methods at foundation level in year 10, they would study Applications at higher level in year 11. Entering the borderline students for foundation assessments in year 10, when they would have a high chance at securing a C grade, was thought to work as a confidence builder. It was anticipated that this increased confidence would help students work hard and achieve well at the higher level the following year, which indeed turned out to be the case.
- Encouraged by the increase in attainment and the level of confidence experienced by middle-attaining students, 'upper' middle-attaining students were also offered the MLP from summer 2011 onwards. Soon after starting to teach set 2, both HoMs said that they wished that they had decided to enter the whole cohort for the MLP, as it appeared appropriate for all students. The whole cohort has been offered the MLP qualifications since summer/autumn 2012.

4.3.2 Delivery

- The centres followed a sequential model of delivery throughout, starting with Methods, on the grounds that students would genuinely get opportunities to achieve a C grade or better only if they had a chance of completing one whole qualification at

the end of year 10. The centre that started its students on the MLP after the May half-term had three hours of lesson time per week, while the school that had a two-year KS4 had four hours per week. At neither centre was there ever a sense that more lesson time would be needed for the MLP than for the single GCSE in mathematics.

- The HoMs at both centres had greatly benefited from various training courses offered by their respective awarding organisations and the National College for Excellence in Teaching Mathematics (NCETM). This training had inspired and helped them to significantly change their pedagogy from a didactic approach to one in which the emphasis was on learning mathematics while having fun. Both HoMs delivered in-house training for their staff, although they would have preferred to take their staff on at least some of the training courses they had benefited from.
- The teachers struggled to find resources to teach Applications at the beginning of the pilot. They had to look at A level resources for some of the new content, including finance and Venn diagrams. Because the teachers had to start from scratch in creating resources to teach (e.g. area under a curve and linear programming), their workload was higher than before in the first year – but once they had created the necessary resources, and freely shared them among each other, their workload returned to normal.
- In terms of school-level interventions that were thought to have contributed positively to the process of implementing the MLP qualifications, both schools had been teaching functional mathematics from year 7 onwards. In addition, literacy issues (which affected lower-attaining students doing Applications) were being targeted at school level, and the schools had increased the level of expectations and tracking of student progression over time across different subjects, including mathematics.

4.3.3 Impact on students

- The significant increase in students' engagement with mathematics and commitment to do well at these centres was seen to be due to three main factors:
 - The MLP course content and the new content in Applications in particular had both required and allowed teachers to change their pedagogic approaches. The new approaches engaged students more than previous, more traditional, approaches.
 - Students had been able to see that the mathematics (Methods) they were doing in year 10 was useful for potential future careers, and the mathematics (Applications) they were learning and using in year 11 might be of use in 'real life'. As a consequence, students had been saying 'When would I ever use this in my life?' less often.

- The sequential model of teaching and assessment that the centres had chosen allowed students to achieve a GCSE at the end of year 10. As a consequence, students realised at the start of year 10 that it mattered how much effort they put into their learning and that, if they worked hard, they would do well and reap the benefits. This had been particularly striking with the middle sets which had been put in for foundation examinations in year 10 and told that, if they achieved a C grade, they would be entered for higher examinations in year 11.
- Students were highly motivated and worked hard because they wanted to go for a higher grade in year 11 – be it from progressing from F to D, C to B, A to A* or getting their second A*. There was a healthy sense of competition among students.
- Attainment in mathematics increased significantly across the board at both schools as a result of the MLP:
 - In one, the percentage of A*–C grades in mathematics has risen from 62% in 2010 to 80% in 2012.
 - In the other, quite a few students doing the MLP, who staff had not expected to get a C at all, got a C grade in at least one of the qualifications. Students who would potentially have got a C grade on the single GCSE also ended up with Bs on the MLP. In the third year of the pilot the department had two students in year 11 who had already got an A* in year 10, whereas normally they would get one A* every three or four years.
- Not only had students found that the MLP engaged them and motivated them to work hard, but the structure of the course and assessments was also cited as a reason for improvement in attainment. The students were reported to understand where they were going, where they were up to and what they needed to do next far more clearly than with the single GCSE, in which students were seen to be ‘just drifting’ and not achieving much for two years.
- Historically, the centres have had a relatively low number of students going on to do A level mathematics. The steady increase in the number of students progressing to A level mathematics was seen to be due to the MLP. For the first time, students from set 2 at both schools had been applying to take A level mathematics.
- The increase in progression rates was attributed to students having had a more intensive two years of mathematical study, with extra demands being placed on them earlier on – this had produced benefits when they got to year 11. Students sensed that they had done more mathematics (evidenced by getting two GCSE) and more interesting mathematics (including investigations), and this had made them feel more confident in the subject and more likely to pick mathematics as an A level. Certain

topics – such as Venn diagrams and linear programming – were thought to have helped to bridge the gap to A level.

4.3.4 Overall impact and lessons learned

- The HoMs at both schools changed their pedagogic approach, and other teachers have made changes to their teaching style as a result of the MLP. The staff had found teaching Applications initially quite challenging and admitted having enjoyed teaching Methods more than Applications, but students' increased level of engagement and attainment won them over. There was a strong sense that teachers would not be returning to their old pedagogic approaches in the future, even were the MLP or similar qualifications no longer available.
- Teachers have taken a risk by making considerable changes to the way they teach and they are encouraging students to take risks as well. The new overall ethos at the departments (evidenced by lesson observations) involves teaching in a way that builds students' confidence to have a go at any task, not to worry about making mistakes but to see where they have gone wrong and correct themselves and each other.
- Specific pedagogic changes implemented at the departments included:
 - Putting more emphasis on unstructured questions and giving the students more time to practise those types of question
 - Not telling students what to do (i.e. how to solve a mathematical problem) but guiding them through the thinking process on how to find out what they need to do themselves
 - Questioning a lot more than they used to: 'Well, what is it asking you? How are you going to find that out? How are you even going to start? What does that mean in mathematics?'
 - Connecting more to the real world and not teaching mathematics as a 'pure' subject – making mathematics meaningful or purposeful by linking it to students' life experiences and what they are hoping to do in the future
 - Including problem solving in every lesson as far as possible with year 10 and 11 students but also lower down in the school (including year 7)
- Because of the overlap in some of the content in Methods and Applications, teachers of the high-attaining sets have taken the opportunity to do more investigative work and projects than when they taught the single GCSE. There has been less time and opportunity to engage in investigative work with the lower sets as a result of the need to revise previously learned content.

- The centres became aware of the importance of improving the tracking of student progression in the early days of the pilot. To get through the content and help students develop the necessary understanding and skills in the same time as was allocated to the single GCSE, the staff had to keep up the pace throughout. As the pace was faster than normal, it became essential to make sure that all students were on track, staff had a clear picture of where each student was at any given time and that students knew what their next target was.
- As part of the newly introduced accurate assessment and tracking strategy, one of the mathematics departments started to assess their students every six weeks. This centre, convinced that there was no time for re-sits, implemented the policy of no re-sits as part of the MLP course.
- When asked what they would improve in the MLP, the HoMs stated that they would like an increase in the amount of finance, and one would also like to see the finance element of the course taken to a personal level.
- Both centres wished they had had the wisdom and courage to enter the whole student cohort for the MLP pilot from the start.

4.4 Case-study cluster 4

Characterised by a focus on **acceleration of all** students

4.4.1 Starting point

- These two schools were high-performing schools with a strong focus on performance measures.
- MLP grades expected and achieved were a strong driver in the decision-making processes.
- These schools were averse to taking risks that might affect examination grade outcomes.
- The schools 'used' the qualifications in an attempt to maximise grades.
- Departments made minimal changes to their pedagogy other than to consolidate the introduction of functionality into the teaching and learning.
- The classes observed showed minimal evidence that the MLP had promoted the pedagogical approaches associated with the wider aims of the MLP.
- These schools withdrew from the pilot because their students did not achieve the expected grades.
- The two schools included in this cluster were both high-achieving 11–18 schools with a mixed-ability intake.
- Both schools had previously been involved in the piloting of functional skills.

- The schools were highly focused on examination results. The opportunities for two attempts at a C grade for D/C grade borderline students and for higher-attaining students to gain two good GCSEs in mathematics were the main reasons cited for joining the pilot, although both schools were also interested in stretching and challenging their higher-attaining students.
- Neither school expected to need to make any significant change to its pedagogy.
- One centre originally entered the full cohort of students; the other was selective, initially only offering the MLP to one higher-tier student group and a D/C grade borderline student group, although opening up to more groups later.
- The centres had hoped that involvement in the MLP would mean better examination results, i.e. higher grades, or at least no drop in grades.
- The centres also saw the opportunity for students to take both GCSEs and to have the best grade 'count' as a major chance to improve grades for D/C borderline students.
- They also expected the MLP to offer good preparation of students for A level mathematics.

4.4.2 Delivery

- The centres used different models of delivery. One centre followed a parallel model of delivery throughout the pilot, where Methods and Applications were taught alongside each other at the same time. The focus was on students taking the assessments in year 10, using year 11 assessments to improve grades. The school had three hours of mathematics teaching a week for higher-tier students and three and a half hours for foundation-tier students. The other centre had three and a half hours of mathematics per week and used an integrated delivery model, teaching Methods and Applications together. This centre continued to teach mathematics in year 11.
- Both centres experienced an initial increase in workload, as teachers adjusted schemes of work, created new resources for the topics that were not covered in any of the textbooks and, in some cases, revisited topics they had not recently taught, such as Venn diagrams.
- Although some more-investigative tasks were introduced into the teaching, there was no significant change to the approaches used. Neither centre reported any particular change to its pedagogy specifically as a result of the MLP. Change was broadly considered part of the current direction of travel, as functionality was in the single GCSE as well.

- The HoMs at both centres thought that the MLP was good preparation for A level. The additional content, especially Venn diagrams, was considered useful for the A level mathematics statistics module and other subjects including statistics (e.g. geography), and learning and applying mathematical methods in ‘real-life’ contexts had made a positive difference.

4.4.3 Impact on students

- Although they liked the MLP, both centres withdrew from the pilot when higher-attaining students did not gain the grades expected, feeling that the benefits the MLP offered were not enough to overcome this fact. The centres felt that students were more likely to gain their expected grades in the single GCSE. There were benefits seen for C/D borderline students, because some students do better in one GCSE than the other and the MLP allows these students the opportunity to have two attempts at gaining a C grade.

4.4.4 Overall impact and lessons learned

- The centres felt that there had been some impact as a result of the MLP but that, with the introduction of functionality in the single GCSE, the centres were already travelling in the same direction, and on the same journey, as the MLP. On withdrawing from the pilot, these centres regretted the loss of the breadth of topics, especially those they valued as preparation for A level.
- The amount of content to deliver within the allocated curriculum time was reported to be an issue for both centres.
- The centres felt that a more personalised approach was required to identify which student groups would be suited to the MLP.

4.5 Case-study cluster 5

Characterised by a ‘pick and choose’ approach

4.5.1 Starting point

- These two schools were high-performing schools with strong, pro-active mathematics departments.
- The schools applied a personalised approach to learning and were interested in how the MLP would benefit specific groups of students.
- Both schools used additional materials to stretch very high-attaining students.
- During the evaluation, consistent use of the pedagogic approaches associated with the wider aims of the MLP in the lessons was observed.
- Both schools were highly focused on the attainment of specific groups of student.

- Before joining the pilot, one centre had introduced the development of students' problem-solving skills in years 7 and 8. Students did nothing else but problem solving from October half-term through to January in year 9, at which point they took the functional skills examinations.
- In one school, the MLP was seen as offering the possibility of providing an alternative 'academically more able' strategy to that offered by the single GCSE combined with an additional mathematics qualification. The department was also looking for opportunities to increase students' depth of mathematical understanding and provide greater stretch and challenge for higher-attaining students.
- In the other school, the MLP was seen as an opportunity to increase one group of foundation-tier students' engagement with mathematics, using an 'option' block to allow more curriculum time.
- Grades attained were an important focus for both centres.

4.5.2 Delivery

- The mathematics department offering the MLP to its highest attainers followed a sequential model of delivery. This was a consequence of the school-level policy that students should have achieved a GCSE qualification in mathematics by the end of year 10. They taught Methods first and had students sit one assessment at a time using all available assessment windows (year 10: January M1, June M2; year 11: January A1, June A2). They started the MLP halfway through year 9 and had four hours of lessons per week throughout the pilot.
- The other centre had only two hours and fifty minutes' normal curriculum time for mathematics. The department used an 'option' block for foundation-tier students to increase the total to five hours per week. The lack of curriculum time meant that the only two student groups taking the MLP were the foundation-tier group choosing the MLP as an 'option' and the top higher-tier set. This centre also followed a sequential approach.
- At the centre that focused on its foundation students in the MLP, the mathematics department had a very high level of autonomy, which meant that teachers could choose the qualification they felt was best suited to their student group. The HoM judged that the foundation group would benefit from the MLP, as it would provide a broader and more engaging curriculum than the single GCSE.
- Staff received some useful training from the awarding organisation but would still have appreciated a training event focused on discussing what they were expected to do 'differently' with the MLP. There was a sense that, had they had that information, they would have changed their pedagogy accordingly.

- The centre offering the MLP to its highest attainers reported that its approach to teaching mathematics had always been one of questioning and encouraging students to give reasons why they came up with a certain answer. There was no difference between the way in which teachers taught Methods in year 10 and the way they had always taught mathematics.
- As this centre did not find there to be enough new content and depth in Applications for their calibre of student, the teachers supplemented the course with more-challenging materials, to develop the problem-solving skills of the students in the very top set in particular – for example, when they were looking at some of the geometry on cones, rather than adopt a ‘this is the formula you need’ approach, teachers encouraged students to spend time looking at where the formula came from and why it worked.
- The other centre felt that there was an additional benefit from having two GCSEs, one of which focused on methods. The HoM felt that the single GCSE had lost some of the ‘raw mathematics’ skills, with its emphasis moving towards the ability to interpret questions.
- Because there had been no time pressure to get through the content in the two and a half years available, one centre had done quite a lot of investigative work with set 1 (A*–A candidates), rather than having a teacher-directed ‘this is how you do it’ approach. The investigative work had involved working on one problem over each teaching week. The centre had not taken the same approach with set 2 (A–B candidates), as the majority of students were not judged to be able to cope with it. The different approach taken with set 1 from that taken with set 2 did not constitute a significant change from what the centre used to do before joining the pilot.

4.5.3 Impact on students

- Both centres found that the MLP promoted a somewhat deeper understanding of mathematics than the single GCSE, but both supplemented the MLP with additional materials. The more investigative approach employed with the top-set students had resulted in these students being more resilient when faced with a complicated and potentially confusing mathematical problem. The higher-attaining students had been more willing to engage with and tackle problems and had developed a greater depth of understanding in the process.
- One centre withdrew from the pilot for two main reasons. First, it felt that the MLP did not contain enough higher-order material to stretch and challenge its high-attaining students, for whom it had hoped the MLP would cater; the second cohort of students did not gain the same very good results that students in the first year of the pilot had

achieved. The second reason for withdrawing was uncertainty over the future of the MLP. The other centre remained enthusiastic about the impact and results for the MLP.

4.5.4 Overall impact and lessons learned

- In the centre in which the school-level policy had determined that a sequential model of delivery was the only option (as one GCSE had to be completed at the end of year 10), the department thought that an integrated approach to teaching, where Methods and Applications were taught simply as mathematics, would have worked much better.
- The centre that had introduced quite a lot of investigative work with the very top set was continuing to teach the top sets in this way even though it no longer offered the MLP.

5 Summary of findings

5.1 How were the MLP qualifications implemented?

5.1.1 Models of delivery

Centres proposed a range of models of delivery, categorised in the case study data as:

- sequential – one GCSE being taught first, followed by the second GCSE
- parallel – the two GCSEs being taught alongside each other as distinct subjects
- integrated – the two GCSEs being taught together.

There was some evidence to suggest that, at least initially, the integrated model was in practice business as usual, involving very little change to teaching and learning. Those centres which had opted for this model, however, commonly moved towards a parallel approach as the examinations approached, feeling that this was a better way to prepare students for the different types of question they were likely to meet in the two examinations. Centres that followed a sequential model of delivery throughout did so on the grounds that students would genuinely get opportunities to achieve a C grade or better only if they had a chance of completing one whole qualification at the end of year 10. Where they had started with Methods, they sought to link the knowledge and understanding developed in year 10 to the skills required for Applications in year 11. In some instances there was a clash between what mathematics departments would like to do and what centre-wide policy determined. For example, there were departments that reported being required to use a sequential model of delivery as a result of centre policy. This meant that students had to complete one mathematics GCSE by the end of year 10 in order to allow for retakes, if necessary, in year 11.¹⁵ Other mathematics departments, however, had a high level of autonomy. This allowed for greater personalisation of the learning for specific groups of students.

Statistical analysis undertaken in autumn 2012 showed that the majority of centres were following a parallel model of delivery. The move to 100% terminal assessment means that it

¹⁵ The only sitting profile which was found to have a significant effect on outcomes among English candidates was the 'sequential' profile, with candidates who fell into this category being associated with slightly lower grade scores than the sitting profile of 'Other'. Candidates following 'parallel', 'linear' and 'other' profiles had similar grades. There were no Welsh candidates who had a 'sequential' sitting profile, so this variable is excluded from the analyses of the Welsh dataset. For both English and Welsh candidates, 'parallel' and 'linear' profiles were found to have no significant effect on the outcome. In all cases, the models on which the above findings are based were shown to predict the outcome of grade score significantly better than the null model. This suggests both that the generated models are a good fit to the data ($p < 0.001$) and that the findings are statistically significant.

is less likely that centres following the parallel or integrated model from September 2012 will have had their year 10 students take assessments in 2013.

The amount of curriculum time given to mathematics varied quite widely, as did views about whether or not the time available was adequate. For the three schools in case-study cluster 1, for example, teaching time varied between three and four hours per week, but none of them felt strongly that the MLP required more time than the single GCSE. Other centres, however, where the time allocation was unchanged at three hours a week for years 10 and 11, considered that more time was needed to deliver the additional content of the MLP effectively. In response, they began to teach the GCSE course earlier in year 9.

5.2 What impact have the MLP qualifications had on the teaching and learning of mathematics?

As was noted in the first interim report, many centres had needed to make considerable changes to their approaches to teaching and learning for the opportunities offered by the MLP to be realised. How far centres were able to do this depended primarily on the extent to which they embraced a more student-led, challenging and open approach in their teaching. Of the initial centres, only a minority did so; in the majority there was little of the kind of high-level questioning that creates opportunities for the development of reasoning, problem-solving skills and making connections with other aspects of mathematics. Additionally, centres expressed concern that more student-led and problem-solving activities, in groups or between peers, would reduce the time available to cover the content, especially in foundation-tier classes. There was a stark difference between foundation-tier and higher-tier lessons in the extent of higher-order questioning and reasoning observed, with little evidence of this being seen at all in the foundation-tier classes.¹⁶ The majority of teachers nevertheless recognised the need to change their teaching approaches and were looking for resources to do this.

Centres were working hard to incorporate more functional elements into their teaching and learning and to apply mathematics to everyday scenarios. In general, they understood the need to teach students how to approach less-structured problem-solving activities, but there was little evidence in the early stages of the pilot of much progress beyond that. A number of centres admitted that they had difficulties with the element of problem solving in the MLP. Several cited time constraints as a reason for not offering more open and investigative work, with this type of activity commonly occurring only at times when the normal timetable was

¹⁶ This is consistent with the findings in the most recent (May 2012) Ofsted report, *Mathematics: Made to Measure*.

collapsed and students could have a 'bit of fun'. In addition, there was evidence of centres being uncomfortable about introducing problem solving into the curriculum because the teachers either were not confident about teaching it, or felt that they did not have the necessary resources to do so.

Scrutiny of a small number of MLP and single GCSE examination papers from the November 2010 and January 2011 series suggested that the examination papers contained some questions that were unstructured and required longer chains of reasoning, and there was a relatively high level of analysing-procedural rather than analysing-conceptual questions in the papers. It was too early at that stage to draw any conclusions from the analysis and scrutiny, given that full suites of live papers were not available. This did, however, reflect the challenges reported by the awarding organisations, which confirmed that examination questions that assess problem-solving skills were being developed and changes made. The effective collaboration between awarding organisations and individuals with a strong interest in mathematics assessment in the understanding and development of assessing problem-solving skills has been a valued outcome of the MLP pilot. A series of workshops initially facilitated by ACME and subsequently hosted by the awarding organisations was considered an effective way of developing new approaches to assessment.

5.2.1 Changes to pedagogy

The implementation of the MLP had the greatest impact on teaching and learning in centres that focused on enriching students' experience of learning mathematics and increasing mathematical understanding, rather than on increasing GCSE grade performance. Those centres in which the focus was fixed on grade performance often reported limited changes to pedagogy, and were inclined to withdraw from the pilot because students' grades had not been as good as they had expected. This is illustrated in the experience of schools in case-study clusters 3 and 4: in the case of the centres in cluster 3, where in one school the percentage of A*–C grades in mathematics had risen from 62% in 2010 to 80% in 2012, the HoMs had completely changed their pedagogic approach. Other teachers also had made significant changes to their teaching style as a result of their involvement in the MLP.

Findings from the online surveys and interviews indicated that centres were enthusiastic about the breadth of learning the MLP offered, although there was a lower level of consensus on the extent to which it promoted depth of mathematical understanding.

Centres recognising that the MLP promoted depth of mathematical understanding felt that this was due to: the breadth of topics, which allowed more connections to be made; greater opportunities for practising the skills, especially problem solving; more opportunities to apply

mathematics by having a whole GCSE that was focused on applications; and an opportunity to introduce pre-calculus work.

Respondents to the online surveys were asked to indicate the extent to which they believed that the MLP and the single GCSE promoted teaching practice that included the use of high-order questioning, stretching and challenging; creating connections, encouraging reasoning, supporting development of strategies for investigation and problem solving, encouraging the recognition of the role of mathematics in everyday life, making learning explicit, and developing 'mathematical' language.¹⁷ The majority of centres that offered the single GCSE as well as the MLP felt that the MLP promoted the pedagogic approaches more than the single GCSE.

5.3 To what extent are the MLP qualifications appropriate for different student cohorts and different centres?

Students' engagement and motivation were felt to have increased where new, innovative teaching methods had been prompted by the introduction of the MLP. Opinion remained divided, however, about the suitability of the MLP for the majority of student groups. Overall, case-study centres considered the MLP to be broadly appropriate for most student groups, provided there was enough curriculum time to teach the additional content. Quite how much time the MLP required appeared to depend on factors such as student cohort, centres' mode of delivery and on when assessments were taken.

The statistical data showed a large proportion of higher-attaining students in the pilot, with many pilot centres reporting that they had used the qualifications to stretch and challenge higher-tier students. Some pilot centres were unwilling to put C/D grade borderline students in for the pilot qualifications, as they did not want to run the risk of students failing to achieve a C grade in mathematics. A relatively large number of centres entered the whole cohort for the MLP, but there remained concerns that the MLP might not be suitable for some lower-attaining students. Their low levels of literacy could result in their struggling to understand what is required when faced with scenario-based/contextualised tasks. There is more applications of mathematics in the MLP than the single GCSE. Academy converter and community schools were the biggest groups taking single GCSE (more than 200,000 candidates). The numbers of candidates from other establishment types decreased quite rapidly. There was a similar pattern seen for centre participation in the MLP, with the

¹⁷ Swan, M (nd) *Mathematics Matters: Final Report*, London: NCETM.
<https://www.ncetm.org.uk/public/files/309231/Mathematics+Matters+Final+Report.pdf>

exception of further education colleges. Although further education was the fifth largest group providing single GCSE mathematics, only one further education college – from Wales – took part in the MLP pilot. However, the college withdrew after entering one small cohort of learners. A small number of FE colleges were interviewed in the early phase of the evaluation. The data collected suggested that the time required for more content and additional assessments may be an issue for adult students. Wider stakeholders interviewed suggested that the emphasis for colleges working with 16–19 year olds was GCSE retakes, so there was less interest in the MLP pilot.

5.4 What impact does the MLP have on students' participation, attainment and progression?

5.4.1 Participation and attainment

Participation was largely determined by centres' perceptions of the value of the MLP and its appropriateness for particular student groups. The statistical analysis shows 839,407 candidates took single GCSE mathematics in 2013, and that 17,447 candidates completed both MLP qualifications in either 2012 or 2013 (i.e. they did either both in 2013, or one in 2012 and one in 2013). This reflects the small-scale nature of the pilot. The percentage of males doing MLP was higher than the percentage of males doing single GCSE mathematics (more than 52% for both Applications and Methods).

The statistical analysis shows that attainment of candidates taking MLP was higher than that of single GCSE candidates. This is true of UMS, mean grade score (on the individual Applications and Methods qualifications) and mean 'best' grade score. The scoring for the two MLP qualifications was highly comparable and both higher than the single GCSE. These findings were also reflected in the case-study data, where centres largely reported improved grades. The exception to this was where centres had made minimal changes to their pedagogy and reported that grades were lower than expected on the MLP. Because of the relatively small number of case-study centres, however, there needs to be caution when interpreting the findings.

5.4.2 Progression

In 2012, most of the pilot centres responding to the online survey that knew what courses their students had progressed to after year 11 felt that the number of students progressing to level 3 mathematics or STEM-related subjects had either largely stayed the same or gone

up. Of the 27 centres reporting a rise in the numbers of students progressing, 14 attributed this rise directly to the MLP.¹⁸

In this interpretation of the findings, a distinction needs to be made in relation to centres' perception of what they think a qualification needs for it to be 'a good preparation for A level study'. The consensus from the majority of HoMs from joint-offer centres interviewed was that the MLP provided a better foundation for A level studies than the single GCSE. HoMs considered that the introduction to a number of additional topics, albeit at a simpler level than that at which students would encounter them at A level, supported progression. The three topics most commonly cited as useful were algebra, pre-calculus (area under a curve) and linear programming.

The greater emphasis on application of mathematics and use of mathematical problem-solving skills was seen to support students in progressing to A level studies. Two-thirds of the HoMs who commented on bridging qualifications felt that these were neither necessary nor desirable: they felt that the MLP enriched and expanded students' knowledge in appropriate ways without the undesirable practice (as several HoMs saw it) of 'fast-tracking' them to A level. They argued that students who undertake bridging qualifications are in danger of lacking motivation at AS, as they will already have covered a lot of the ground at that level in their bridging qualifications.

That said, a third of the HoMs interviewed were using or planning to use bridging qualifications.¹⁹ They thought that these were useful and necessary to stretch and challenge their highest-attaining students, as the MLP was not more difficult than the single GCSE. They welcomed the opportunity that the bridging qualifications offered to deepen students' grasp of the most difficult GCSE topics and provide them with 'a trial run of AS level'. HoMs liked the large amount and depth of algebra and the way in which the bridging qualifications engaged students in calculus and differentiation.

¹⁸ DfE 'The independent evaluation of the pilot of the linked pair of GCSEs in mathematics (MLP), fourth interim report', London: DfE.

¹⁹ *Ibid.*

5.5 What is the ‘value’ of the MLP qualifications over and above what is offered by the single GCSE?

Based on the perceptions of pilot centres offering the MLP and the single GCSE:

- The MLP was thought to provide more stretch and challenge to higher-attaining students than the single GCSE, which was reflected in proportionately more higher-attaining than lower-attaining students having been selected for the MLP.
- Because of its additional topics, greater emphasis on application of mathematics, use of mathematical problem-solving skills and, to some extent, because students found it more engaging, the MLP was also seen to provide a better foundation for A level studies than the single GCSE, and thus to aid progression.
- The three topics that were cited as most useful in stretching and challenging students and supporting progression in the MLP were algebra, pre-calculus (area under a curve) and linear programming.
- A large majority thought that the MLP encouraged a broader understanding of mathematics than the single GCSE, with the four most valued topics in the MLP being finance, linear programming, Venn diagrams and set theory. Two of the reasons cited for the popularity of these topics were that they offered a good preparation for A level and that they were the areas of mathematics that students saw as most relevant.
- Although a smaller majority held the view that the MLP encouraged deeper mathematical understanding than the single GCSE, those who did cited the breadth of topics (which allowed more connections to be made), greater opportunities for practising problem-solving skills, more opportunities to apply mathematics, and an opportunity to introduce pre-calculus work.

6 Conclusion

Mathematics, the Smith report suggested, occupies something of a special position:

It is a major intellectual discipline in its own right, as well as providing the underpinning language for the rest of science and engineering and, increasingly, for other disciplines in the social and medical sciences. It underpins major sectors of modern business and industry, in particular, financial services and ICT. It also provides the individual citizen with empowering skills for the conduct of private and social life and with key skills required at virtually all levels of employment.²⁰

This acknowledgment of the importance of mathematics finds echoes in the views of secondary pupils as recorded in the most recent Ofsted report (2012) – but with a significant caveat. It remains a concern, the report noted, that pupils seemed so readily to accept the view that learning mathematics is important but dull. They told inspectors that, whereas in other subjects they enjoyed regular collaboration and discussion of their ideas, this seldom happened in mathematics lessons, nor did they expect it to do so. Frequently, their comments also exposed a recognition that their understanding of mathematics was insecure. An able student summed this up:

You need to understand and not just do it. You think you know how to do it but you get to an exam and you can't. You realise that nobody's told you why it works and why you do what you do, so you can't remember it.²¹

These are central concerns that the MLP sought to address.

In their response to the DfE Consultation on Key Stage 4 Qualification Reform, ACME identified a number of lessons which they saw as having been learned from the MLP pilot.²² They argued that the pilot and, to a lesser extent, the new single GCSE had shown that it was possible to create an assessment which better measured what is valued in mathematics, such as problem solving. It had shown the value of having greater assessment space, in order to assess the range of mathematics topics. This had resulted in teaching and learning that was closer to curriculum intentions. In the MLP, this was achieved by having

²⁰ DfES (2004) *Making Mathematics Count: The Report of Professor Adrian Smith's Inquiry into Post-14 Mathematics Education*, London: DfES, para 0.5.

²¹ Ofsted (2012) *Mathematics: Made to Measure*, Manchester: Ofsted, para 42.

²² ACME (nd) 'Response to the Department for Education Consultation on Key Stage 4 Qualification Reform'.

separate assessment in methods in mathematics and applications of mathematics, in which each was seen as equally valued and weighted.

ACME suggested that other valuable lessons had resulted from the MLP, including:

- Two exams means that greater value is placed on the subject by a range of stakeholders, who see it as equivalent to English and science
- Extra content requires extra teaching time
- Awarding organisations working together results in better assessment, even in a competitive situation
- Quality teacher support and resources significantly improve teaching quality
- Time is needed to develop better assessment and teaching practice; one should not expect big changes overnight

The evaluation has emphasised the different learning journeys for case-study centres. Common to most, however, is the need for time – time to implement change effectively within a centre, but also time in the classroom to allow for a more dialogic, interactive approach to teaching and learning that supports the development of reasoning and problem-solving skills.

There needs to be more emphasis on the different types of problem solving and the different learning that results from them. The MLP pilot has led to some effective collaboration between awarding organisations in an attempt to develop a greater understanding of the development of questions to assess problem solving. Although progress in the teaching of problem solving has been seen during the pilot phase, some teachers would like further support in this area of their teaching. There has continued to be a focus in centres on ‘problem solving’ in terms of generic skills, with problems being presented as words with arithmetical steps or worded contexts that require the student to decide to use standard techniques. Findings from the fieldwork suggest that there has been less focus on problem solving in terms of mathematical ways of thinking. One of the most positive messages to emerge from the pilot, however, was that with some centres there was a strong sense that teachers would not be returning to their old – and less engaging – pedagogic approaches in the future, even were the MLP or similar qualifications to be no longer available.

7 Appendix 1: Data collected over the lifetime of the evaluation of the MLP (autumn 2010–summer 2013)

Report	Evaluation topics	Statistical data	Online survey data	Centre visit data	Centre phone interview data	Wider stakeholder data	Document review data
Pre-pilot report	Pre-pilot planning, preparation and communication Pilot centres' state of readiness Pilot centres' and wider stakeholders' expectations of the impact, risks and issues of the linked pair of GCSEs in mathematics	Awarding Body Data Archive (ABDA – awarding organisation data supplied by QCDA) Statistical First Releases (SFR) (from DfE Research Gateway) Joint Council for Qualifications (JCQ) data National Pupil Database (NPD), including census, Pupil Level Annual School Census (PLASC) and examination results	Centre survey as part of EMP survey on GCSE mathematics (368 responses = 10% of secondary schools in England)	Fourteen case-study pilot centres: in-depth interviews and focus groups Five single-GCSE-only centres: in-depth interviews		Twenty interviews with wider stakeholders Introductory interviews with the four participating awarding organisations	Awarding organisation and Ofqual documents; QCDA pilot communication strategy, June 2009

Report	Evaluation topics	Statistical data	Online survey data	Centre visit data	Centre phone interview data	Wider stakeholder data	Document review data
First interim report	<p>Centre and student participation and engagement in the pilot</p> <p>Changes to teaching and learning as a result of the pilot qualifications and their assessment</p> <p>The extent to which changes to teaching and learning parallel those resulting from the introduction of the new single GCSE in mathematics</p>		Pilot centre online survey (112 responses = 46% of 244 pilot centres)	<p>Thirteen case study pilot centres: 18 lesson observations, in-depth interviews and focus groups</p> <p>Three single-GCSE-only centres: in-depth interviews</p>			Scrutiny of 26 examination papers from four awarding organisations across three specifications and two tiers (Nov 2010 and/or Jan 2011)

Report	Evaluation topics	Statistical data	Online survey data	Centre visit data	Centre phone interview data	Wider stakeholder data	Document review data
Second interim report	<p>The extent to which the wider aims of the MLP are recognised by stakeholders and perceived to offer value over and above what is offered by the single GCSE</p> <p>The perceived impact of the MLP on students' engagement with, and learning and understanding of, mathematics</p> <p>The appropriateness of the MLP qualifications for different cohort groups and centre types</p> <p>The extent to which wider policy changes are likely to affect the behaviour of centres and their attitude towards offering a pair of GCSEs</p>	<p>Statistical attainment data from three awarding organisations (AQA, Edexcel, OCR), as WJEC first award only in 2012.</p> <p>National Pupil Database (NPD) on prior attainment and census information</p>	Pilot centre online survey (105 responses = 39% of 267 pilot centres)	Ten case study pilot centres: 17 lesson observations, in-depth interviews and focus groups	<p>Eleven joint-offer centre HoM interviews</p> <p>Twenty-two single-GCSE-only HoM interviews</p>	<p>Ten interviews with wider stakeholders</p> <p>Focus group with the four participating awarding organisations</p>	
Third interim report	<i>Topics as in 'Second interim report', as third interim report built on and complemented the second interim report</i>			Four case-study pilot centre visits: seven lesson observations, in-depth interviews and focus groups	Ten case-study pilot centre follow-up interviews		

Report	Evaluation topics	Statistical data	Online survey data	Centre visit data	Centre phone interview data	Wider stakeholder data	Document review data
Fourth interim report	<p>The potential 'value' of the MLP qualifications over and above what is offered by the single GCSE</p> <p>The impact of the MLP qualifications on the teaching and learning of mathematics</p> <p>The appropriateness of the MLP qualifications for different cohorts of students and centre contexts</p> <p>The (early) implications of the move from unitised to linear (or 100% terminal) assessment</p>	<p>Statistical attainment data from four awarding organisations (AQA, Edexcel, OCR, WJEC)</p> <p>National Pupil Database (NPD) on prior attainment and census information</p> <p>Edubase data on school characteristics</p> <p>Ofsted data on school effectiveness (England)</p>	<p>Pilot centre online survey (70 responses = 25% of 280 pilot centres)</p>		<p>Thirty-two joint-offer centre HoM interviews</p>	<p>Focus group with the four participating awarding organisations</p>	
Fifth interim report	<p>The potential 'value' of the MLP qualifications over and above what is offered by the single GCSE</p> <p>The appropriateness of the MLP qualifications for different cohorts of pupils and centre contexts</p> <p>The impact of the MLP qualifications on the teaching and learning of mathematics</p>			<p>Eight case-study pilot centre visits: 16 lesson observations, in-depth interview</p>	<p>Five case-study pilot centre HoM in-depth interviews</p>		

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