



Department
for Education

Evaluation of the Mathematics Specialist Teacher (MaST) programme

Research report

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“It has been a real privilege to be part of such an exciting programme and work alongside our fantastic HEI and our link course leader. I hope it will continue for many years to come”.

(Local authority consultant).

“This has been a brilliant course to increase the subject knowledge, pedagogic knowledge and confidence of teachers”.

(Local authority consultant).

“This programme is brilliant. It’s fantastic to see the progress of these teachers in their ability to improve in their subject knowledge and the development of their pedagogy”.

(Independent mathematics consultant).

“One of the most frequent comments I have heard is that the programme is the best CPD experienced. This is claimed to be related to the length of the programme with time to explore ideas over time, the repeated return to discussion groups which stay the same over the two years so strong personal bonds build, and the opportunity to read research materials which would otherwise pass by a busy teacher...Schools regularly ask when there will be similar programmes for literacy and science which suggests that they, too, value the quality of the programme, and MaST teachers frequently refer to changes they have made in other subjects that they teach based on study on this programme”.

(Independent mathematics consultant).

“Teachers and headteachers have declared this as the best CPD ever offered and very much recommend that it continues”.

(Local authority consultant).

“We all believe that the MaST Programme continues to be an excellent initiative and highly inspirational”.

(Local authority consultant).

“All MaST teachers are excited, enthusiastic practitioners who can see the worth in what they are doing and are enjoying the course. It has changed their practice and perceptions of what ‘good’ mathematics teaching is and they are all keen to ensure that this is further developed within the teaching profession”.

(Local authority consultant).

“For me it’s the most exciting thing I’ve done in my career. They come to me and say “it’s the best CPD I’ve ever had”, and “I’ve never had CPD that’s had such a profound effect on my practice”. And that’s not just one or two, it’s the vast majority”.

(HEI consultee).

“The course design, content and procedures are commendable and comparable with the best international practice”.

(HEI external examiner).

“I have been in education for about 20 years and this is the project that has had the most impact that I have been involved in. I have seen a really positive impact on teachers themselves, on the school they work in, and on individual teachers within those schools”.

(HEI consultee).

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Executive Summary

1. Background and introduction

1.1 Report brief

This is the final report of the three-year evaluation of the Mathematics Specialist Teacher (MaST) Programme, which was undertaken by the National Foundation for Educational Research (NFER) with SQW between September 2010 and September 2012. The MaST Programme was developed in response to the recommendations of the Williams Review¹. It is a school improvement programme focusing on primary mathematics being delivered with four cohorts of teachers. The MaST Programme includes the development of the mathematics specialist's subject knowledge and pedagogical skills and the mathematics specialist working with other teachers in school to share learning, to develop their knowledge and skills, and to impact on standards of mathematics teaching across the school.

The evaluation draws on survey findings data from Cohort 1 and 2 Mathematics Specialist Teachers (MaSTs), headteachers and their pupils, set against a group of teachers and pupils in comparison schools. In addition, data has been collated from Cohort 1 and 2 case-study schools as well as from programme deliverers. A value for money analysis and an analysis of pupil attainment data has also been undertaken.

1.2 MaST Programme aims and objectives

The aim of the MaST Programme is to provide each participating teacher with a Masters-level programme of training and professional support in order that they can carry out their mathematics specialist role **working with** teachers in their school. The programme also aims to build additional mathematics capacity across the primary school system to improve the quality of mathematics teaching and learning.

These aims of the MaST Programme are pursued through the three key objectives of the programme:

- to develop the mathematical subject knowledge of participating teachers so that they gain a deep knowledge of mathematics within the Early Years Foundation Stage (EYFS) and primary curriculum

¹ Williams, P. (2008) Independent Review of Mathematics Teaching and Learning in Early Years Settings and Primary Schools.

- to promote good understanding of a fit-for-purpose pedagogy that enables participating teachers to draw on a wide repertoire of teaching approaches
- to develop the expertise of the mathematics specialist in working with colleagues and to provide effective professional development of colleagues through classroom-based collaborative professional activity (for example, lesson study approaches, coaching and mentoring).

1.3 MaST Programme structure

The MaST Programme is a two-year Masters-level national programme delivered through partnerships between higher education institutions (HEIs) and local authorities (LAs). Although the evaluation focused on the experiences of Cohorts 1 and 2, a total of four cohorts have participated, or are currently participating, in the programme²:

- Cohort 1, who commenced the MaST Programme in January 2010 and completed the programme in December 2011
- Cohort 2, who commenced the MaST Programme in September 2010 and completed the programme in August 2012
- Cohort 3, who commenced the MaST Programme in September 2011 and will complete the programme in August 2013
- Cohort 4, who commenced the MaST Programme in September 2012 and will complete the programme in August 2014.

While the broad structure of the programme has been largely similar across all four cohorts, funding has been reduced from 2011. This includes reductions in funding for supply time to support MaSTs to work collaboratively with their colleagues in schools and to allow MaSTs' time out of the classroom to attend meetings with programme deliverers. The aim has been for schools to start to take on some of the costs of the programme themselves and, in line with other similar programmes, after Cohort 4 the programme will move to a market model, with transitional funding provided to support this.

The following eight HEIs are delivering the MaST Programme:

- The University of Brighton

² The national roll-out of the programme was preceded by the one year Mathematics Specialist Pathfinder Programme which was launched in October 2008 with 56 teachers from seven local authorities. Teachers attended locally run half-termly, half-day meetings and an HEI-run Easter school of just over two days.

- Edge Hill University
- The Institute of Education, leading a consortium involving King's College London and Roehampton University
- Manchester Metropolitan University, leading a consortium involving Liverpool Hope University
- The University of Northampton, leading a consortium involving Bishop Grosseteste University College Lincoln, Nottingham Trent University, the University of Bedfordshire, the University of Derby and the University of Hertfordshire
- The Open University
- Sheffield Hallam University
- The University of Winchester, leading a consortium involving Canterbury Christ Church University, the University of Greenwich and the University of Reading.

Each year, the MaSTs are expected to engage with the following programme elements:

- five days (30 hours) face-to-face contact with the HEI provider out of school hours
- six local authority run half-day (18 hours) extended meetings
- a half-day (three hours) local authority visit to the school by the lead mathematics consultant (undertaken jointly with HEI staff in some cases) to meet with the headteacher and mathematics specialist
- 11 days (66 hours – one day following each of the HEI and local authority sessions) in-school classroom focused work and work alongside colleagues (planning and analysis, work in teacher's classroom and working alongside colleagues)
- self-supported study of approximately 83 hours, for example mathematics audits, maintaining the professional learning log, reading, online discussion and networking and assignments.

1.4 Research design

The evaluation covers the first three years of delivery of the MaST Programme, focusing on the experiences of Cohorts 1 and 2.

The first stage of the research involved **identifying a comparison group of schools** which was broadly similar to the MaST schools in terms of size, geography, attainment, and eligibility for free school meals (FSM). The creation of this comparison group was integral to assessing the additionality of changes observed within MaST schools and deriving value for money estimates. The creation of the comparison group allowed relative performance of MaST schools to be compared with similar schools using survey data.

To capture the impacts of the programme on Cohort 2 MaSTs and their schools, **baseline, midpoint and endpoint surveys** were conducted in January 2011, September 2011 and June 2012 respectively with:

- headteachers in Cohort 2 MaST schools
- Cohort 2 MaSTs and comparison teachers.

Due to the timing of the evaluation, it was not possible to conduct a baseline survey of Cohort 1 MaSTs and so a **one-off survey** was undertaken instead. This was conducted in June 2011. A comparison group was not used for this survey.

In order to provide the most complete picture of the impact of the mathematics specialist role, the findings from the baseline and endpoint surveys undertaken with Cohort 2 MaSTs form the central source of survey data presented in this report. Findings from the Cohort 1 MaST survey were broadly similar across all questions to those of the Cohort 2 endpoint survey. They were reported in an earlier report and are not reported separately here.

Staff questionnaires were returned from:

Cohort	Survey	Headteachers	MaSTs	Comparison teachers
		(n)	(n)	(n)
1	One-off (June 2011)	480	468	-
2	Baseline (January 2011)	385	415	203
	Midpoint (September 2011)	399	392	289
	Endpoint (June 2012)	480	324	240

In addition, baseline and endpoint surveys were administered to pupils in Key Stage 1 and Key Stage 2 in both Cohort 2 MaST and comparison schools in September 2011 and June 2012 respectively. The pupil surveys were designed to capture pupils' general attitudes towards mathematics and their views on, and experiences of, their mathematics lessons.

Pupil surveys were returned from:

Cohort	Survey	MaST schools		Comparison schools	
		Key Stage 1	Key Stage 2	Key Stage 1	Key Stage 2
		(n)	(n)	(n)	(n)
2	Baseline (September 2011)	1,037	3,077	475	1,758
	Endpoint (June 2012)	1,075	2,735	497	1,529

In order to gather a more in-depth understanding of the implementation and impact of the MaST Programme, three rounds of teacher/school case-studies were undertaken between September 2011 and July 2012. A total of 31 contacts with schools were undertaken, with a total of 24 different schools being involved in the case-study phase of the evaluation.

At three time points telephone interviews were also undertaken with representatives from each of the eight higher education institutions (HEIs) and proformas were returned from local consultants (both local authority (LA) and independent consultants).

The report includes a value for money analysis of the delivery costs for Cohort 1 and 2 of the programme compared against the benefits. In addition, statistical analysis was undertaken to explore whether there was any evidence that participation in the programme had improved the attainment of year 6 (Key Stage 2) and year 2 (Key Stage 1) pupils, relative to the performance of pupils in the comparison group of schools. A full explanation of the analyses undertaken can be found in the technical appendices.

2. Development and delivery of the MaST Programme

2.1 Programme management and staffing

The **overall responsibility for the management, planning and delivery of the MaST Programme has lain with eight lead HEIs**. In four cases the programme has been developed and delivered by a lead HEI within a consortium of HEIs (ranging from two to five HEIs).

HEIs have worked with local authority staff in their delivery of the programme and **the input of local authority staff has been very important**. In some cases, local authority staff have been involved at the overall programme level in terms of agreeing the aims, structure and ways of working and planning the content. This has particularly been the case for local authority staff involved in the Pathfinder stages of the programme. In other cases, their involvement has primarily related to the planning of the content for, and the delivery of, the local network meetings.

In many cases, HEIs have continued to work with their link local authorities for the duration of Cohort 1 and 2. However, the delivery of the MaST Programme has been affected by redundancies of mathematics consultants in local authorities, or changes in consultants' role to a more generalist function. **Despite these changes, continuity and high quality in programme delivery has been maintained in the vast majority of areas.**

2.2 Programme content and delivery

The MaST Programme comprises three key strands which include the development of: subject knowledge, pedagogical knowledge and working with colleagues. Most HEI and local authority interviewees have suggested that a key strength of the programme has been its focus on mathematics subject knowledge content. However, a small number of consultees have suggested that the programme would benefit from an additional focus on leadership and action planning although others have emphasised that they would not want the focus on mathematics subject knowledge to be diluted.

In general, both HEI days and local network meetings have been structured around the three key strands of the programme. However, in some cases, the focus of the HEI days has been on developing subject knowledge, with the focus of the local network meetings being more on pedagogies and collaborative working with colleagues. HEI sessions and local network meetings have covered both areas of mathematics content (such as measures, shape, time, division and fractions), as well as pedagogy and the effective use of different resources (such as mathematics talk and using models and images). In addition, teachers have explored progression in mathematics from the early years through the primary phase (for example the principles of counting through the age ranges) and pupil misconceptions.

2.3 Overall what has worked well and why?

The **balance within the MaST Programme between academic learning and practical application has been very effective and** the vast majority of consultees have reported the effectiveness of the practical focus of the programme, as well as its integration of theory with practice.

The programme's **focus on three key and significant areas to improve mathematics in schools - subject knowledge including progression across the Key Stages, pedagogy and collaborative working with colleagues - has also been very effective,** with one HEI consultee echoing the comments of others by describing the content as 'spot on'.

2.4 What have been the challenges?

The MaST Programme has been delivered within a fast changing policy context. Since its inception in January 2010, it has experienced **changes in relation to both funding and staffing.** This has included reductions in funding to pay for supply time to support MaSTs to work collaboratively with

their colleagues in schools and to allow MaSTs time out of the classroom to attend meetings with programme deliverers (see section 1.3 above). In addition, in many local authorities, there have been redundancies of mathematics consultants, or changes in their role to take on a more generalist function. In most cases, these challenges have been effectively overcome but, in some cases, they have impacted on the effectiveness of the programme as explored below.

3. MaSTs' experiences of the programme

3.1 Views on components of the MaST Programme

MaSTs were asked to rate on a 1-to-5 response scale (where 1 was 'very useful' and 5 was 'not at all useful'), how useful they had found the different components of the programme in terms of developing their teaching of mathematics.

The **three programme components that MaSTs found the most useful were attending the local half-day network meetings, collaborative working with colleagues at their schools, and attending HEI sessions, with 90 per cent, 89 per cent and 85 per cent respectively of MaSTs responding with a 1 ('very useful') or 2 response.**

MaSTs were then asked which component of the programme had led to the greatest impact on the way in which they taught mathematics. The single highest response was attending HEI sessions (37 per cent), followed by attending the local half-day network sessions (31 per cent).

3.2 Factors for success

A range of facilitating factors have supported teachers to successfully complete the MaST Programme and, in particular, to undertake their whole school improvement role working with staff from across their school. These factors are explored below.

Support from the senior leadership team has been crucial for the success of the MaST's collaborative work in school. Another key factor for success in relation to MaSTs' whole school improvement role has been the **seniority of the MaST**, for example being part of the senior leadership team or already being the school's mathematics lead or coordinator. Already having a senior and or/mathematics-related role has meant that headteachers have been

more likely to support their MaST with time and financially (e.g. for supply cover) and in setting aside time during meetings and within the INSET plan to incorporate MaST activities. In addition, staff in senior roles have had more flexibility in how they use their time and have found it easier to encourage other staff to take on MaST-related activities due to the respect they already have in school.

3.3 Barriers and challenges

Some MaSTs have experienced barriers to their successful completion of all aspects of the MaST Programme, particularly the whole school improvement component. In many cases, these barriers are the mirror images of the factors for success.

As well as the key issue of time, a lack of senior leader support to work with colleagues across the school has been a challenge that some MaSTs have faced which one MaST described as ‘not catching fire whilst the sparks are there’. Often this has occurred in schools where practice in mathematics has been perceived to be already effective or where the school has had other pressing priorities, such as literacy and supporting pupils with English as an Additional Language (one headteacher described trying to tackle all priorities as ‘spinning plates’). In addition, some headteachers have seen this as a task for the MaST to undertake once they are free from the demands of the programme.

A lack of teaching experience, or confidence in their mathematics ability, has been a barrier for some MaSTs in embedding MaST practices across the school. A reduction of local authority support for Cohort 2 teachers in their second year of the programme has meant that they have not had someone external ‘backing them up’ and convincing the headteacher and staff to embrace MaST, as this Cohort 2 MaST explained: ‘Without the LA support, there is nobody to back me up that what I’m saying is right’. One headteacher commented that the programme could usefully build in more support to help junior staff grow into the mathematics coordinator role and take on managerial and more strategic functions.

4. Impacts on teachers

4.1 Teachers' perceptions of impacts on the effectiveness of their teaching practice

4.1.1 Findings from the surveys

In order to gauge the perceived impact of the programme on MaSTs' teaching practice, MaSTs and their headteachers who responded to the survey were asked **to what extent the participating teacher's mathematics teaching practice had improved overall** as a result of their involvement in the MaST Programme. They were asked to rate their views on a five-point scale, where 1 was 'to a great extent' and 5 was 'not at all'.

MaSTs were highly positive about the extent to which they had improved their teaching practice throughout the programme, with the vast majority (92 per cent) responding with a 1 or 2, and over half (52 per cent) providing a 1 response ('to a great extent'). None of the teachers reported that the MaST Programme had not had an impact on their teaching practice at all (see Table B.32 in Appendix B). These views were echoed by headteachers, the vast majority (83 per cent) of whom responded with a 1 or 2 and over one-third (34 per cent) provided a 1 response ('to a great extent') (see Table A.10 in Appendix A). This suggests that, overall, **both headteachers and MaSTs were in agreement that the programme had had a positive impact on participating teachers' practice.**

Headteachers were also asked to what extent their teacher's participation in the programme had made a difference to their **confidence** to teach mathematics to a range of abilities, and their use of a broad range of teaching approaches and materials.

Most headteachers reported that the programme had impacted on their teacher's confidence to teach mathematics to a range of abilities, with a large majority (81 per cent) responding with a 1 or 2. Headteachers were **even more positive about the impact of the programme on teachers' use of a broad range of teaching approaches and materials**, with, again, a large majority (86 per cent) responding with a 1 or 2.

4.1.2 Findings from the case studies

Case-study participants echoed the views of MaSTs and headteachers who participated in the surveys, reporting that involvement in the MaST Programme had increased their **confidence and effectiveness in using a range of teaching methods.** This was considered to be a fundamental impact arising from the programme. Whilst closely linked with associated

improvements in their subject knowledge, MaSTs had particularly benefited from the opportunity to explore, test out and apply new approaches to teaching mathematics.

MaSTs also reported an increased focus in their and colleagues' lessons on:

- risk taking and 'thinking outside of the box'
- using questioning and getting pupils to explain their thinking (including 'talking for learning') which deepens understanding of core concepts
- mental mathematics (for example two MaSTs reported using mental and oral starters at the beginning of lessons to instill an understanding of mathematical concepts such as place value and to tackle misconceptions)
- developing pupils' reasoning and understanding, for example spotting differences and patterns
- teaching pupils strategies for quicker ways of getting answers
- tackling misconceptions head on and getting pupils to explain why something is wrong
- progression in mathematics through the year groups and Key Stages
- using visual aids, games, quizzes and cards with pictures and symbols.

4.1.3 The views of HEI and local authority deliverers

HEI and local authority deliverers corroborated the views of MaSTs and their colleagues, reporting very strong impacts in terms of MaSTs' pedagogy and on the quality of their own teaching. In many cases, the leadership of mathematics within their school was also reported to have improved. MaSTs were reported to speak confidently about their knowledge and understanding of mathematics teaching and learning and felt that they had some degree of specialism in this area. Impacts had been seen for less experienced teachers as well as those who had been mathematics subject leaders for some years and who had attended a lot of professional development in the past.

4.1.4 The views of pupils

Further insights on teaching approaches were obtained from the pupils themselves. The research included **questionnaire surveys of pupils** in MaST schools and in comparison schools in June 2012, the endpoint of the programme. The results below derive from the Key Stage 2 pupil questionnaire, to which a sample of 2,735 pupils in MaST schools and 1,529 pupils in comparison schools gave responses.

The children were asked about the **frequency with which they undertook a variety of mathematics activities**, of the kind that might be expected to increase with teachers' participation in the MaST Programme. They answered using a five-point scale: 'All the time', 'Most of the time', 'Sometimes', 'Hardly ever' or 'Never'. Since a variety of activities were covered, it is relatively unlikely that many would attract the response 'All the time'. To take account of this, a mean frequency was calculated on a scale of 1-5 and these means were used to compare the two groups, in preference to the percentage selecting each option.

The analysis revealed significant differences between MaST pupils and comparison pupils in five out of the seven activities investigated, with **pupils of MaSTs recording significantly greater frequency** in the following:

- 'To learn mathematics, we do activities outside our classroom (such as in the playground or the computer room)'
- 'We do practical activities to learn mathematics (such as using measuring scales, measuring tapes, rulers or stop-watches)'
- 'We use things other than a pencil and paper to learn mathematics (such as calculators, cubes, number lines or number grids)'
- 'We work with partners to learn mathematics'
- 'We learn mathematics that helps with everyday life (such as money and counting)'.

4.2 Teachers' confidence in their subject knowledge of mathematics across the Key Stages

4.2.1 Findings from the surveys

MaSTs responding to the survey were asked to rate their confidence in their mathematics subject knowledge across the Key Stages of the primary curriculum and beyond. Participating teachers were presented with a five point scale where 1 was 'very confident' and 5 was 'not at all confident', and were asked to decide where they positioned themselves within this spectrum.

MaSTs were most confident about their subject knowledge of mathematics at Key Stage 2, with over nine out of ten teachers (92 per cent) responding with a 1 or a 2, and just under three-quarters (73 per cent) responding with a 1 ('very confident'). The vast majority of MaSTs who

participated in the survey were teaching at Key Stage 2 so, not surprisingly, they were most confident about the Key Stage they were most familiar with.

Additional analysis revealed that, when compared to the baseline, **many MaSTs had gained confidence in their subject knowledge of mathematics across the Key Stages, and at a much greater rate than their counterparts in the comparison group of schools.** The greatest gain was in subject knowledge at Key Stage 2.

In addition to more general positive views about the impact of the MaST Programme on teachers' subject knowledge, there was evidence that teachers' confidence across many specific areas of primary mathematics had increased. Teachers were asked to what extent they were confident in their subject knowledge of mathematics in seven areas of the primary curriculum *within the Key Stage that they currently taught*. These areas included:

- using and applying mathematics
- counting and understanding number
- knowing and using number facts
- calculating
- understanding shape
- measuring
- handling data.

Analysis revealed that, when compared to the baseline, MaSTs had gained confidence at a much greater rate than their counterparts in the comparison group of schools. The greatest gain was in 'using and applying mathematics'.

4.2.2 Findings from the case studies

Several of the case-study MaSTs reported **improvements in their mathematics subject knowledge** as a result of participating in the programme. This applied both to the Key Stages in which MaSTs themselves taught, as well other Key Stages taught within the school. This was particularly notable in instances where MaSTs had worked with colleagues to improve continuity between Key Stages, and to draw out connections and relationships between different mathematics topics.

In particular, MaSTs reported that the programme had enabled them to **address specific areas of weakness** in their own understanding (e.g. algebra, trigonometry). This was particularly true of Cohort 1 MaSTs, who

reported that this helped them to feel more assured when teaching these themes, and more confident to share their subject knowledge with others.

4.3 Impacts on teachers' involvement in, and ability in undertaking, professional development activities: frequency of activity

4.3.1 Findings from the teacher and headteacher surveys

To ascertain teachers' involvement in, and ability undertaking, professional development activities, Cohort 2 MaSTs responding to the survey were asked how frequently they had undertaken a range of professional development activities with colleagues over the last year, and how confident they were in undertaking these activities.

The findings revealed that:

- the activity that MaSTs were most frequently engaged in was 'offering advice to colleagues on mathematics-specific pedagogies' with 45 per cent reporting they did this half-termly or more
- this was followed by 'supporting colleagues with planning of mathematics lessons, 'mentoring/coaching another member of staff on mathematics teaching' and 'leading small staff meetings on mathematics-specific issues', with around one-third (35 per cent) of teachers reporting that they engaged in these activities half-termly or more
- the most infrequent activities were 'collaborating on a 'lesson study' approach with a colleague' and 'supporting colleagues with planning of mathematics lessons' (28 per cent and 27 per cent respectively)
- the activities most frequently reported as having 'never' been undertaken were 'leading a whole-school meeting on mathematics as part of a school closure day' and 'collaborating on a 'lesson study' approach with a colleague' (22 per cent and 18 per cent respectively) (see Table B.33 in Appendix B).

Additional analysis revealed that, when compared to the baseline, many MaSTs were now undertaking these professional development activities with colleagues more frequently, and in some cases, considerably more frequently than their counterparts in the comparison group of schools.

4.4 Impact on standards of teaching and learning and on whole school improvement

4.4.1 Findings from the teacher and headteacher surveys

Teachers were asked to what extent their involvement in the MaST Programme had impacted on a range of areas within their school.

The findings revealed that MaSTs perceived the programme to have positively impacted on many aspects of teaching and learning across their school. Most strongly, MaSTs reported that the programme had impacted on the **priority given to improving the quality of mathematics teaching and learning, and to improving attainment and standards in mathematics**, with 71 per cent and 69 per cent of teachers respectively providing a 1 or 2 response to these areas. Headteachers echoed these views, with 78 per cent and 76 per cent giving a 1 or a 2 response respectively (see Table A.11 in Appendix A).

4.4.2 Findings from the case studies

Many of the case-study participants reported **impacts on the quality of mathematics teaching exhibited by MaSTs' teaching colleagues**. This reflects a similar strength of feeling expressed about MaSTs' own teaching practice, although some participants observed that it was difficult, and in some cases too early, to measure the strength of impact felt by colleagues.

4.5 Impacts on participating teachers' roles and career progression

Evidence was collected to suggest that the MaST Programme had already benefited or had the potential to benefit teachers' career progression. For example, in response to a question on their role, about three out of ten MaSTs (31 per cent) said that they had been promoted or taken on a new responsibility as a result of their involvement in the MaST Programme (see Table B.11 in Appendix B). Of these MaSTs, almost half (48 per cent) reported they had become the mathematics coordinator. Other key ways in which teachers reported their roles had changed as a result of their involvement in the MaST Programme included:

- becoming a member of the senior management team/leadership team (14 per cent)
- taking on a wider mathematics role (e.g. local authority adviser) (12 per cent)
- coaching/training colleagues (10 per cent)
- becoming a deputy headteacher (10 per cent).

4.6 Modelling the overall impact on MaSTs

The preceding sections have reported in some detail the responses of MaSTs and their headteachers and have commented on the distance travelled between the baseline and endpoint surveys and differences between MaST and comparison teachers. To determine the impact that can be attributed to the MaST Programme with greater rigour, a multiple regression model was employed³. The model identified significant differences that could be attributed to participation in the MaST Programme, at the same time as any differences attributable to background characteristics. In this way, the multiple regression model controlled for the possible differences in background characteristics between MaST and comparison samples and made it possible to quantify the impact of participation in the programme for the teachers. Full details of the analysis undertaken can be found in Chapter 5 of the main report and in the technical appendices.

4.6.1 Impact on the confidence and self-efficacy of MaSTs

The MaST Programme aimed to achieve significant improvements in the ability of teachers to teach mathematics effectively across all aspects of the subject, both within and outside the primary Key Stage in which they were currently teaching. The questionnaires gave a measure of how far the MaSTs believed that this had been achieved. Their views on this were expressed as their confidence in teaching mathematics and their beliefs about their own effectiveness, often described as self-efficacy.

The multiple regression analysis revealed that **MaSTs' confidence in their ability to teach the range of mathematics across the primary Key Stages had improved very significantly more than that of comparison teachers.** The gains were moderate for Key Stage 2 and above and for participants' own Key Stage, and stronger for Key Stage 1 and below and outside the participants' own Key Stage. Since more participating teachers were in Key Stage 2 than below, this finding reinforces that there were greater gains in confidence outside the teachers' own Key Stage, rather than within it. It is to be expected that teachers would have greater confidence in the Key Stage with which they were familiar, so the greater increases in less familiar Key Stages is a noteworthy outcome of the programme.

³ The aim of this was to take into account not only whether respondents were MaSTs or comparison teachers, at baseline or endpoint, but also the background characteristics of the respondents. This made an important contribution to establishing the counterfactual, that is, a measure of what would have happened in the absence of the MaST Programme, an important indicator of impact.

In addition, **there was clear evidence that participation in the MaST Programme has had a very significant positive impact on teachers' self-efficacy as mathematics teachers.** This included MaSTs' self-efficacy in progression and assessment (e.g. setting high expectations, integrating assessment, challenging the most able pupils), in making links with mathematics (e.g. mathematics in the real world, connections across the mathematics curriculum), and in using a range of teaching approaches (e.g. practical resources).

4.6.2 Impact on the collaborative practice of MaSTs

Whilst MaSTs' feelings of confidence and self-efficacy are important, the programme sought also to have an impact upon their practice. Further analysis examined this, and in particular the distance travelled in terms of frequency of collaborative working and support for colleagues in teaching mathematics. **MaSTs reported an increase in their collaborative practice that was significantly greater than that in comparison schools.** This extended to collaborative activities *outside* the classroom, such as leading staff meetings and giving advice, and those *inside* the classroom, such as lesson study.

5. Impacts on pupils

5.1 Impacts on pupils' attitudes

The research revealed a number of positive impacts on pupils' attitudes towards, and confidence in, mathematics as a result of the MaST Programme. Whilst these impacts were most strongly felt by pupils in the MaSTs' own classes, participants suggested that impacts had begun to emerge more widely amongst pupils taught by other teachers in the MaSTs' schools. The findings are discussed in detail in the following sub-sections.

5.1.1 Findings from the teacher surveys

In the view of the MaSTs who participated in the survey, **the MaST Programme had had a positive impact on the attitudes of pupils in their school.** On a five point scale where 1 was 'to a great extent' and 5 was 'not at all', almost three-quarters of MaSTs (72 per cent) gave a 1 or a 2 response to indicate the impact of the programme on pupils' *enjoyment* of learning mathematics, and just over two-thirds (67 per cent) gave a 1 or 2 response when asked about the impact of the MaST Programme on pupils' *confidence* in learning mathematics (Table B.42 in Appendix B).

5.1.2 Findings from the pupil surveys

Further evidence was obtained by surveying the pupils themselves. The questionnaire surveys of pupils in MaST schools and in comparison schools in June 2012 (endpoint survey) included a number of questions relevant to this area. The pupils were asked about their attitudes towards mathematics, including measures of enjoyment, aspiration and confidence. The analysis sought out significant differences between those pupils taught by MaSTs and those in the comparison schools, at the endpoint of the evaluation.

In many cases, differences between the MaST and comparison samples proved slight and not statistically significant. **The Key Stage 1 questionnaire, which comprised a small number of simple statements such as ‘I like mathematics’ to gauge enjoyment and ‘I am good at mathematics’ to indicate confidence, gave rise to no significant differences between the MaST and comparison samples.** Levels of enjoyment and confidence were fairly high among both groups of children, with 64 per cent of children agreeing that they liked mathematics and 59/56 per cent believing they were good at mathematics (see Tables D.3-D.9 in Appendix D).

The Key Stage 2 questionnaire included a wider range of questions and more answer options, to probe the views of these older children more thoroughly. Similarly to Key Stage 1, there were no significant differences between MaST and comparison pupils in most questions measuring *enjoyment* of mathematics: ‘I enjoy mathematics’, ‘I like to learn new things in mathematics’, ‘Maths is one of my favourite subjects’ and ‘I like the way we learn mathematics’. Overall, as with the younger pupils, the attitudes of these Key Stage 2 children towards mathematics were quite positive, with 60-75 per cent of the sample assenting to these statements by selecting ‘all the time’ or ‘most of the time’.

There was, however, one question on *enjoyment* where the MaST pupils gave significantly more positive responses than those in the comparison schools. **‘I find mathematics interesting’ gave rise to 69 per cent in MaST schools responding ‘all the time’ or ‘most of the time’, as against 64 per cent in comparison schools, and this difference was statistically significant.** Further, there was a statistically significant difference in responses to the question about aspirations in mathematics **‘I would like to do a job with some mathematics in it when I grow up’: 32 per cent of MaST pupils responded ‘yes, a lot’ as against 26 per cent in comparison schools.** In fact, there were also slightly higher proportions of MaST pupils who responded positively to all of the *enjoyment* questions, but none of these

differences quite attained statistical significance. **The pupil questionnaire at Key Stage 2 therefore yielded some suggestion that children’s views on enjoyment of mathematics backed up those of their teachers** (see Tables E.3-E.11 in Appendix E).

Finally, on aspirations in mathematics, the Key Stage 2 questionnaire revealed no differences between the MaST group and the comparison group for the statements ‘Learning about mathematics will help me to get a job when I’m an adult’ and ‘Learning about mathematics will be useful in my everyday life when I’m an adult’.

Overall, differences between MaST and comparison pupils at both the baseline and endpoint were small. Although there is a suggestion of more positive enjoyment amongst MaST pupils at the endpoint, this is only tentative.

5.2 Impacts on pupils’ attainment, skills and capabilities

This section explores the impact of the MaST Programme on the attainment, skills and capabilities of pupils. First, it explores the statistical evidence for the impact on attainment using data from the National Pupil Database (NPD). Second, it explores the perceptions of consultees collected through the survey and interview data.

5.2.1 Multilevel modelling results

The aim of the analysis was to estimate the impact of the MaST Programme on the attainment of pupils at Key Stage 1 and Key Stage 2 in Cohort 1 schools. The analysis compared the results of pupils in MaST schools to the performance of pupils in other schools. Full details of the analyses undertaken can be found in Chapter 5 of the main report and in the technical appendices. The following outcomes were analysed:

- Key Stage 1 mathematics teacher assessments
- Key Stage 2 mathematics test results

The comparison between pupils in Cohort 1 MaST schools and pupils in other non-MaST schools⁴ was made both for 2009 and 2011 results. The aim of the analysis was to discover if there were significant differences between these groups of schools in terms of the rate of progress between 2009 and 2011.

Analysis showed that once differences in background characteristics were taken account of:

⁴ Cohort 2 schools are excluded from the comparison group.

- for Key Stage 1 mathematics, MaST Cohort 1 schools had significantly lower achievement in 2009 compared to comparison schools. Although statistically significant this difference was actually very slight; just 0.11 points on average. The gap between MaST and other schools narrowed by 0.04 points by 2011, however, this change was not statistically significant
- for Key Stage 2 mathematics there was no significant difference between MaST schools and other schools in 2009. Additionally the difference in the rate of change in results between 2009 and 2011 was not statistically significant.

The findings suggest that the involvement of at least one teacher in a school in Cohort 1 of the MaST Programme has not yet had a significant impact upon the attainment of pupils at Key Stage 1 or Key Stage 2.

Further analysis was undertaken to explore whether an impact could be detected where the MaST was actually teaching the same year group as those pupils being assessed at Key Stage 1 and Key Stage 2. However, this analysis did not find evidence of any difference between schools where the MaST was teaching years 1 and 2 or years 5 and 6.

The lack of conclusive statistical evidence on the impact of the programme on pupil attainment may be influenced by a number of factors. The period of time over which attainment data was analysed was relatively short and it may take longer for impact to become apparent (e.g. as teachers consolidate their new skills and/or disseminate these more widely amongst colleagues, or if pupils perform consistently better in later Key Stage tests as a result of the earlier intervention). Evidence from the case studies also suggests a view from some MaSTs and their colleagues that the skills acquired by pupils as a result of the programme were not always assessed in the national tests, and therefore, perceived improvements in pupils' mathematical abilities did not necessarily translate into improved exam results. Moreover, many consultees interviewed as part of the evaluation reported that MaST-school pupils were better able to tackle mathematical problems in a range of contexts than they were prior to their teachers' becoming involved in the programme. If true, it seems likely that their enhanced understanding and appreciation for mathematics is likely to lead to an improved aptitude for and fluency in mathematics in later life. The results contrast with the strength of the findings from the survey and case-study research which are presented below.

5.2.2 The findings from the surveys

MaSTs and comparison group teachers were asked what progress, on average, the pupils in their class had made over the last full school year. **Almost three-quarters of MaSTs (72 per cent) responded that their pupils' progress had been 'considerably better' or 'somewhat better' than expected, with just under one-quarter (24 per cent) reporting that progress had been 'considerably better'**. None of the MaSTs reported that their pupils had made 'somewhat below the expected progress' (see Table B.35 in Appendix B). Similar responses were given by comparison teachers, but MaSTs' responses represented a notable improvement to those collected at the baseline, when only seven per cent of respondents said progress was 'considerably better than expected' (see Table F.68 in Appendix F).

MaSTs also appeared to indicate that improvements and progress in pupils' achievement could be largely attributed to the MaST Programme itself. On a five point scale where 1 was 'to a great extent' and 5 was 'not at all', just under three-fifths (59 per cent) of MaSTs gave a 1 or a 2 response to impact of the MaST Programme on pupils' progress in mathematics, and 55 per cent gave a 1 or 2 response when asked about the impact on pupils' attainment in mathematics.

The most commonly mentioned reasons for pupils' increased achievement and progress in mathematics were: teachers developing an increased understanding and knowledge of mathematics (10 per cent), greater focus on 'using and applying' mathematics (six per cent), and greater use of practical resources and activities (six per cent). A further six per cent, however, reported that pupils had achieved above the expected progress as a result of cohort differences (see Table B.36 in Appendix B).

5.2.3 Findings from the case studies

Alongside improvements in pupils' attitudes and confidence, case-study participants reported that there had also been considerable impacts on pupils' skills and capabilities in mathematics. MaSTs reported that pupils were now **much more aware of their own personal targets in mathematics** and were considerably more independent in their approaches to learning. For example, children now followed their own lines of enquiry in lessons, without the MaST spelling out the learning objectives at the beginning of the session. Pupils themselves reported that they liked having different ways of learning mathematics, rather than just learning out of text books. They understood why they were learning mathematics and felt they were improving, even though their lessons were getting harder.

MaSTs also observed that pupils were more content to verbalise their experiences of learning mathematics and were therefore more confident to undertake questioning and reasoning activities and use descriptive language. MaSTs also reported that some of the group work undertaken by pupils had increased confidence: for example, asking pupils to come up with answers in a group rather than as an individual was felt to promote confidence amongst children who might not otherwise put themselves forward. Pupils themselves reported that they now liked mathematics more because it was practical and fun, and because they were not embarrassed about making mistakes. They commented that their teachers allowed them to work at their own pace, so they could feel confident about what they were learning.

Whilst the greatest reported impacts on pupils related to their attitudes and capabilities, some case-study participants cautiously indicated that the MaST Programme may have resulted in **moderate impacts on pupil attainment**. However, participants emphasised that there were a wide range of measures aimed at improving pupil attainment in mathematics: the MaST Programme was just one of these measures and positive changes in pupils' abilities should not, therefore, be viewed in isolation. In addition, several schools suggested that it was too early to measure impact in relation to attainment: in some cases, this was because schools felt that impacts on attainment were only likely to emerge in the longer-term (in the most marked example of this, a MaST reported that fostering pupils' positive disposition towards mathematics in Key Stage 1 might only translate into improvements in achievement at GCSE level and beyond).

6. Value for Money

In analysing NPD data on Key Stage 1 and Key Stage 2 results, we sought to identify longer term additional outcomes which might have resulted from the overall programme objectives having been achieved. As already discussed, our analysis found no evidence of improved attainment at this stage. However, this is in line with the findings from the most comparable programme for which we have data, the earlier Every Child Counts (ECC) evaluation⁵, which also failed to reveal any significant impact on pupil attainment. The key ECC programme was Numbers Count (NC), which

⁵ We identified the Every Child Counts (ECC) as the only suitable intervention against which the MaST Programme could be benchmarked for the purposes of the value for money assessment, due to the lack of comparable analysis and evaluation evidence on other programmes. The Every Child Counts intervention was introduced in 2007, with a commitment to provide support to 30,000 six year old pupils (focused on the lowest achieving 5 per cent of Key Stage 1 children) by 2010/11 (see Every Child Counts: the independent evaluation executive summary, Torgerson, C.J. et al (March 2011) DFE-RBX-10-07)

provided one-to-one and very small group support to pupils through a specialist trained Teaching Assistant. The aim was to raise the performance of the lowest achieving children so that they were on par with their peers by the end of Key Stage 1⁶.

When comparing ECC and the MaST Programme it is important to note that the foci of the two interventions were different. Whilst ECC targeted a specific group of children requiring support in mathematics, the MaST Programme sought to improve teacher confidence and skills in mathematics through a model in which they shared their new skills with colleagues. In this respect the MaST Programme had the potential to benefit a wider group of pupils. Despite the differences in approach taken by the two programmes, the MaST evaluation approach has allowed for a broadly similar replication of the economic aspects of the ECC evaluation.

Our assessment of programme efficiency suggests that costs incurred in delivering the MaST Programme, on a per teacher, per school and per pupil basis were positive when benchmarked against the ECC evaluation. For example, the lifetime cost of the MaST Programme (Cohort 1 and 2) for each school that had one or more MaSTs were **£7,111 per school** (or c.£3,550 per year of the programme). This would appear efficient when compared to the total average schools costs of the ECC programme, which were £59,586 per school over a four year period (or c.£14,897 per year). In other words, the cost of running the MaST Programme per school and per year, were approximately a quarter that of the ECC programme. Furthermore, the MaST model of cascading knowledge within schools meant the programme was intended to benefit all children, rather than a specific group of children (as was the case for the ECC programme).

The lifetime programme costs (Cohort 1 and 2) for teachers completing the MaST Programme were **£7,356 per teacher** (or c.£3,678 per year). This compares with £13,589 per annum for a 50 per cent FTE teacher delivering Numbers Count on a one-to-one basis, as part of the Every Child Counts programme. For reasons already highlighted, the two programmes are not directly comparable given the differences in delivery model, but on the basis of the data we have it would appear that the MaST Programme has been delivered with efficiency in the context of per teacher costs.

The lifetime programme cost (Cohort 1 and 2) for each pupil in schools with a MaST is estimated at **£26 per pupil**. These estimates indicate that the

⁶ Numbers Count consisted of a 12 week programme, with daily 30 minute sessions for the target children. The programme provided funding to help schools employ and train specialist Numbers Count Teachers (NCTs).

programme has been cost efficient when compared with the Every Child Count Programme which was estimated to have cost an average of £1,353 per child (where children were taught on a one-to-one basis). That said, the two programmes are not directly comparable given the ECC programme was based on a support model working with small numbers of pupils, whereas the MaST Programme was intended to benefit all children in schools with a participating teacher. A full explanation of the analyses reported above can be found in Chapter 6 of the main report.

7. Sustainability and legacy of the support being provided to Cohort 1 and 2 MaSTs

This section explores the sustainability and legacy of the MaST Programme in relation to the support being provided to Cohort 1 and 2 MaSTs to continue to develop their mathematics expertise. It also explores the extent to which MaSTs were starting to undertake mathematics-related activities with other schools in their local areas.

7.1 Continuation of support for professional development

There are encouraging signs that there is some continuation of support for MaSTs to further develop their mathematical expertise and their use of pedagogies. However, this varies by local authority area and, in many cases, relates to whether the local authority in which they are based has retained its primary mathematics consultants. Where primary mathematics consultants are still in post, local authorities are, in the main, committed to ensuring the ongoing development of qualified MaSTs and their role in supporting other schools.

As well as the local authorities, some of the HEIs are devoting time and energy to supporting the continued development of Cohort 1 and 2 MaSTs. For example, two HEIs are continuing to run meetings for MaSTs to support their ongoing networking. One of these HEIs is running mathematics networks for all mathematics leads/coordinators in their area and MaSTs are leading some of the sessions. These meetings are being facilitated by a local authority consultant who has recently been employed by the HEI. However, it is likely to be MaSTs who live in close proximity to the HEI facilitating the meetings that will attend these meetings due to travel time and cost. In some cases, HEI staff are attending networking sessions run by local authorities.

More commonly, HEIs have organised celebration events for MaSTs and their headteachers and have started to run annual MaST conferences. In addition,

HEIs are keeping in touch with MaSTs through email, for example to alert them to new developments and research in relation to mathematics. One HEI consultee mentioned that they have set up a Facebook page to support MaSTs to keep in contact and others are using alumni for this purpose.

7.2 The roles that MaSTs are starting to play within their local authority

Just over a fifth (22 per cent) of surveyed Cohort 2 MaSTs reported that they had already worked with other schools to support their development and improvement of mathematics. Three-fifths (59 per cent) of teachers reported that they had not yet worked with other schools to support their development and improvement and a further **17 per cent reported that planned to do so, or that this was currently under development** (See Table B.45 in Appendix B). Of these, MaSTs most commonly planned to provide direct support for teaching and to hold cluster meetings with colleagues in other schools (in 58 per cent, and 35 per cent of cases respectively).

8. Conclusions and recommendations

The Mathematics Specialist Teacher Programme has made a valuable contribution to enhancing participating teachers' subject knowledge, pedagogical skills and collaborative working skills, resulting in meaningful impacts at the whole-school level. There is empirical evidence to suggest that the MaST Programme model has been effective in fostering deeper and more secure subject knowledge in participating teachers. The combination of HEI sessions and local network meetings has provided an integrated and comprehensive training experience for teachers. The theoretical underpinnings delivered through the HEI sessions have complemented the focus of local network meetings on teachers' assessments of their own skills and the practical application of learning in teachers' own classrooms. The evidence collected suggests that participating teachers have benefited immensely from the networking opportunities provided in both of these forums and from the cohesive and supportive networks that have developed at a local level.

Mathematics specialists have reported that the programme has positively impacted on many aspects of teaching and learning across their schools. In particular, MaSTs have reported that the programme has impacted on the priority given to improving the quality of mathematics teaching and learning, and to improving attainment and standards in mathematics. Although

embedded from the start, year 2 of the programme appears to have involved a greater emphasis on working with colleagues, on mentoring and coaching, and on approaches to supporting colleagues, such as lesson study. As a result, there is evidence that the programme has developed the expertise of the mathematics specialist in working with colleagues and in providing effective professional development of colleagues.

The evidence for the impact of the programme on pupils is more mixed. In the view of the participating teachers, the MaST Programme has made a positive impact on pupils in terms of their enjoyment of and confidence in mathematics. This perception is only partly supported by the findings from the pupil surveys. There is a suggestion that pupil enjoyment of mathematics at Key Stage 2 is now higher in MaST than comparison schools, but this is not conclusive, and there is some indication that pupil confidence levels are actually higher in comparison schools. In addition, almost three-quarters of MaSTs reported that their pupils' attainment has been better over the previous 12 months than expected, and this proportion has increased substantially since the baseline survey. However, the analysis of pupil attainment data suggested that this perception has not yet been borne out by national assessment results.

8.1 Recommendations

The report concludes by presenting the following recommendations for consideration by the Department for Education, for Higher Education Institutions, local authorities and other CPD providers and for schools who want to improve the quality of their mathematics teaching.

8.1.1 Recommendations for the Department for Education

- **The Department should endorse and promote the programme to primary schools as it moves to a market model beyond Cohort 4.**

Overall, the study has found that the MaST Programme has made a considerable positive impact on participating teachers' subject knowledge and confidence to teach mathematics and has positively impacted on pupils' enjoyment of and confidence in mathematics. Although not conclusive, there is some evidence to suggest that the programme has also led to improvements in pupils' attainment. These are messages that should be promoted and celebrated at the national, regional and individual school level. Failure to endorse the programme beyond Cohort 4 risks jeopardising its future uptake and continued impact as well as reducing the value and currency of Mathematics Specialist Teacher status to schools.

- **The Department should consider using the MaST Programme as a model for strengthening teaching and learning in other subject areas.** Overall, the evidence collected suggests that the programme has been a success. As such, it should be considered as a potential model for driving improvement in primary schools by developing primary teachers' knowledge and pedagogical skills in other subject areas, such as science. In addition, the MaST Programme shows that an intensive, systematic and nationally available subject specific CPD programme can be a particularly effective mechanism for improving standards of teaching across a school. The programme's focus on collaboration within and between schools could also be a model that is taken forward by the Teaching Schools Alliance, while those successful teachers could become Specialist Leaders of Education. Many of the key aspects of the programme, such as: the combination of HEI sessions and local network meetings led by a subject specialist; in-school classroom focused work; work alongside colleagues, including coaching and mentoring; and the self-supported study strand could be elements of programmes in other subject areas. Moreover, the initial period of funding has helped to pump-prime the programme ahead of what will hopefully become a successful market expansion; an approach that could be used with future subject-specific CPD programmes.
- **The Department should consider tracking the pupils in MaST schools to see if pupil attainment and progression improves over the longer term.** One limitation of the evaluation was that the period of time over which pupil attainment data was analysed was relatively short and it may take longer for impact to become apparent (e.g. as teachers consolidate their new skills and/or disseminate these more widely amongst colleagues, or if pupils perform consistently better in later Key Stage tests as a result of the earlier intervention). Many consultees interviewed as part of the evaluation reported that MaST-school pupils were better able to tackle mathematical problems in a range of contexts than they were prior to the MaSTs becoming involved in the programme. If true, it seems likely that their enhanced understanding and appreciation for mathematics is likely to lead to an improved aptitude for and fluency in mathematics in later life.

8.1.2 Recommendations for Higher Education Institutions, local authorities and other CPD providers

- **HEIs, local authorities and other CPD providers could strengthen their training and professional development offer to teachers by combining theoretical content with opportunities for teachers to**

apply their learning in a practical way. They should also look for opportunities to help facilitate local level discussions and support. Many consultees reported that the focus of local network meetings on teachers' assessments of their own skills and the practical application of learning in teachers' own classrooms had complemented the theoretical underpinnings delivered through the HEI sessions. In addition, many MaSTs described the local network meetings as the best element of the programme due to them allowing MaSTs to discuss practice, share ideas and issues and ask questions in small, local, close-knit groups in which they all learnt from each other. The local network meetings clearly added value and were a key mechanism for the success of the programme. HEIs, local authorities and other CPD providers should continue to offer this type of activity and engage individuals with deep subject-specific and pedagogical knowledge and understanding of school contexts to facilitate them.

- **HEIs, local authorities and other CPD providers should continue to target and involve senior school leaders from the outset when promoting intensive and ongoing training and professional development activities to teachers.** The commitment of a school's senior leadership team was considered to be an essential component of successful engagement in the programme. Most HEIs recognised the importance of senior staff buy-in. However, some appeared slower than others in developing an engagement strategy for them, but found that once in place, this helped with recruitment and the smooth running of the programme.
- **In partnership with local authorities and schools, HEIs should consider putting in place arrangements to support MaSTs when they complete the programme.** While there is some evidence that a number of local authorities and HEIs are putting in place structures to support MaSTs to continue their development and are drawing on MaSTs' learning and skills to improve mathematics teaching within their local area, it is a mixed picture and, in some local areas, no such support is being provided. The potential benefits of following up with MaSTs are considerable, and include: reinforcement of learning; consolidating links with local authority staff/consultants; sharing experiences with current cohorts; strengthening relationships with and between schools; collecting evidence of impact over the longer term; facilitating and sustaining teachers to become reflective practitioners; and encouraging teachers to pursue further study options.

8.1.3 Recommendations for schools

- **Schools should encourage their mathematics specialists to continue to develop support networks at a local and regional level.** The evidence collected suggests that participating teachers have benefited immensely from the networking opportunities provided by both the HEI and local network meetings and from the cohesive and supportive networks that have developed at a local level.
- **Subject specialists with deep subject and pedagogical knowledge need to be given the support and authority to lead and influence teaching and learning in order to effect whole school change.** A key factor for success in relation to the MaST's role in impacting on standards of mathematics teaching across the school has been the seniority of the MaST, and, linked to this, the MaST's confidence in undertaking CPD with staff across the school. The MaST Programme shows that mathematics subject specialists provided with the authority by senior leaders to influence practice in primary schools can be effective in championing mathematics and in promoting best pedagogical practice, both within their school, and within other schools.
- **Schools should promote a positive culture of continuous professional development which continually deepens the subject and pedagogical knowledge of staff.** The Williams Review (2008) posited that confidence and dexterity in the classroom are essential prerequisites for successful teachers of mathematics, and that this confidence stems from deep mathematical subject and pedagogical knowledge:
 - schools can improve their standards of mathematics teaching and learning by continuously developing the subject-specific expertise of one or more members of staff, in addition to the skills and capacity of these staff to support, develop and upskill colleagues across the school
 - schools without a MaST should consider drawing on the experience and expertise of schools with MaSTs. Such partnerships could provide non-MaST schools with innovative and effective practice examples for improving teaching and learning and making mathematics more accessible and relevant to children. MaST schools also stand to benefit by giving their mathematics specialists the experience of coaching teachers in partner schools and developing their skills further.

1. Introduction

This is the final report of the three year evaluation of the Mathematics Specialist Teacher (MaST) Programme which was undertaken between September 2010 and September 2012.

1.1 Background

In his Independent Review of Mathematics Teaching and Learning in Early Years Settings and Primary Schools⁷ (The Williams Review), Sir Peter Williams argues that ‘most initial teacher training (ITT) does not in itself constitute a sound basis for deep subject and pedagogical knowledge in mathematics’. The Williams Review goes on to emphasise the importance of teacher continuing professional development (CPD) in developing the teaching and learning of mathematics, with the principal recommendation being that ‘there should be at least one Mathematics Specialist within each primary school, in post within 10 years, with deep subject and pedagogical knowledge, making appropriate arrangements for small and rural schools’.

The Mathematics Specialist Teacher (MaST) Programme has been developed in response to the recommendations of The Williams Review. It is a school improvement programme focusing on mathematics, being rolled out with four cohorts of teachers. The MaST Programme includes the development of the mathematics specialist’s subject knowledge and pedagogical skills and the mathematics specialist working with other teachers to share learning, to develop their skills and to impact on standards of mathematics teaching across the school.

1.2 MaST Programme aims and objectives

The aim of the MaST Programme is to provide each participating teacher with a Masters-level programme of training and professional support in order that they can carry out their mathematics specialist role **working with** teachers in their school. The programme also aims to build additional mathematics capacity across the primary school system to improve the quality of mathematics teaching and learning.

These aims of the MaST Programme are pursued through the three key objectives of the programme:

⁷ Williams, P. (2008) Independent Review of Mathematics Teaching and Learning in Early Years Settings and Primary Schools.

- to develop the mathematical subject knowledge of participating teachers so that they gain a deep knowledge of mathematics within the Early Years Foundation Stage (EYFS) and primary curriculum
- to promote good understanding of a fit-for-purpose pedagogy that enables participating teachers to draw on a wide repertoire of teaching approaches
- to develop the expertise of the mathematics specialist in working with colleagues and to provide effective professional development of colleagues through classroom-based collaborative professional activity (for example, lesson study approaches, coaching and mentoring).

1.3 MaST Programme structure

The MaST Programme is a two year Masters-level national programme delivered through partnerships between higher education institutions (HEIs) and local authorities (LAs). Although the evaluation focused on the experiences of Cohorts 1 and 2, a total of four cohorts have participated, or are currently participating, in the programme⁸:

- Cohort 1, who commenced the MaST Programme in January 2010 and completed the programme in December 2011
- Cohort 2, who commenced the MaST Programme in September 2010 and completed the programme in August 2012
- Cohort 3, who commenced the MaST Programme in September 2011 and will complete the programme in August 2013
- Cohort 4, who commenced the MaST Programme in September 2012 and will complete the programme in August 2014.

While the broad structure of the programme has been largely similar across all four cohorts, funding has been reduced from 2011. This includes reductions in funding for supply time to support MaSTs to work collaboratively with their colleagues in schools and to allow MaSTs' time out of the classroom to attend meetings with programme deliverers. The aim has been for schools to start to take on some of the costs of the programme themselves and, in line with other similar programmes, after Cohort 4 the programme will move to a market model, with transitional funding provided to support this.

⁸ The national roll-out of the programme was preceded by the Mathematics Specialist Pathfinder Programme which was launched in October 2008 with 56 teachers from seven local authorities. Teachers attended locally run half-termly, half-day meetings and an Easter school of just over two days.

The following eight HEIs are delivering the MaST Programme:

- The University of Brighton
- Edge Hill University
- The Institute of Education, leading a consortium involving King's College London and Roehampton University
- Manchester Metropolitan University, leading a consortium involving Liverpool Hope University
- The University of Northampton, leading a consortium involving Bishop Grosseteste University College Lincoln, Nottingham Trent University, the University of Bedfordshire, the University of Derby and the University of Hertfordshire
- The Open University
- Sheffield Hallam University
- The University of Winchester, leading a consortium involving Canterbury Christ Church University, the University of Greenwich and the University of Reading.

A total of 120 local authorities across England have been involved in the programme. Each of these local authorities has partnered with a 'link' HEI to deliver the programme. For a full list of the local authorities involved in Cohorts 1 and 2 of the MaST Programme, and their link HEI, please see Appendix 2.

A total of 1,592 teachers were recruited onto the programme for Cohort 1 against a target of 1,800, representing a take-up of 88 per cent of allocated places. For Cohort 2, 1,228 teachers were recruited against a target of 1,720, representing a take-up of 71 per cent of allocated places. Table 1.1 below provides details of the numbers of teachers recruited onto the programme by each HEI set against their initial allocations. An overall retention figure is provided showing the percentage of teachers completing the programme as a proportion of those who started it. A throughput figure has also been calculated showing the percentage of teachers completing the programme as a proportion of the target numbers. While the figures for the numbers of teachers completing Cohort 2 are provisional, they suggest that Cohort 2 has experienced greater teacher withdrawal from the programme than Cohort 1, while the throughput was substantially lower⁹.

⁹ There appears to have been a higher proportion of teachers going on maternity leave in Cohort 2 which may account for the greater teacher withdrawal. This was the main reason

Table 1.1 Recruitment figures and allocations for Cohort 1 and 2 by HEI

HEI	Target	Teachers recruited	Completers	Retention rate	Proportion of throughput target achieved
Cohort 1			(actual)		
Institute of Education	200	180	142	79	71
Edge Hill University	300	256	191	75	64
University of Brighton	60	60	46	77	77
Open University	200	151	124	82	62
Manchester Metropolitan University	170	158	119	75	70
Sheffield Hallam University	190	181	140	77	74
University of Winchester	310	261	227	87	73
University of Northampton	370	345	279	81	75
Totals	1,800	1,592	1,268	-	-
Overall retention rate for Cohort 1: 80%					
Overall proportion of throughput target achieved for Cohort 1: 70%					
Cohort 2			(estimated April 2012*)		

given by schools/teachers for those withdrawing from the Cohort 2 endpoint survey and was supported by the views of some HEI interviewees.

Institute of Education	250	134	82	61	33
Edge Hill University	210	184	143	78	68
University of Brighton	60	60	44	73	73
Open University	210	142	93	65	44
Manchester Metropolitan University	170	123	92	75	54
Sheffield Hallam University	150	94	60	64	40
University of Winchester	340	204	170	83	50
University of Northampton	320	287	253	88	79
Totals	1,710	1,228	937	-	-
Overall retention rate for Cohort 2: 76%					
Overall proportion of throughput target achieved for Cohort 2: 55%					

* Cohort 2 participants will complete the MaST Programme in September 2012 and therefore these figures should be treated as estimates of final completions.

Source: DfE monitoring data

Each of the lead HEIs is responsible for developing and providing the materials for the programme, as well as accrediting the resulting award, which counts for 60 CAT points at Masters Level. HEIs have also been responsible for joint planning and delivery of the materials, alongside their respective local authorities. Since its inception in January 2010 there have been changes to both funding and staffing with local authority staff/local coordinators now being directly contracted and paid for by the HEIs.

Local coordinators are responsible for delivering aspects of the programme material through a series of half-day meetings and in-school visits.

Each year, the MaSTs are expected to engage with the following programme elements:

- five days (30 hours) face-to-face contact with the HEI provider out of school hours
- six local authority run half-day (18 hours) extended meetings
- a half-day (three hours) local authority visit to the school by the lead mathematics consultant (undertaken jointly with HEI staff in some cases) to meet with the headteacher and mathematics specialist
- 11 days (66 hours – one day following each of the HEI and local authority sessions) in-school classroom focused work and work alongside colleagues (planning and analysis, work in teacher's classroom and working alongside colleagues)
- self-supported study of approximately 83 hours, for example mathematics audits, maintaining the professional learning log, reading, online discussion and networking and assignments.

The cost of the HEI element of the programme to date, which covers both Cohorts 1 and 2, is shown in Table 1.2.

Table 1.2 Funding allocated to HEIs and average cost per student per year

HEI	Funding allocated to HEIs, by year				Total	No of students completing Cohort 1 and 2*	Average cost per student per year*
	09/10	10/11	11/12	12/13 (forecast)			
Institute of Education	154,996	480,470	538,169	225,754	1,399,389	224	£3,124
Edge Hill University	276,734	573,822	500,388	232,594	1,583,539	334	£2,371
University of Brighton	62,927	161,182	178,199	50,597	452,905	90	£2,516
Open University	484,613	672,639	211,198	62,202	1,430,652	217	£3,296
Manchester Metropolitan University	2,516	364,021	365,586	106,252	838,375	211	£1,987
Sheffield Hallam University	120,469	413,731	347,896	64,693	946,789	200	£2,367
Winchester University	375,857	801,076	462,098	194,782	1,833,813	397	£2,310
Northampton University	459,938	927,924	846,775	266,079	2,500,717	532	£2,350
Total	1,938,049	4,394,866	3,450,309	1,202,954	10,986,178		

* The figures for Cohort 2 are based on estimates of final completions and as such should be treated as indicative.

Source: DfE monitoring data.

Other programme costs, including the funding paid to local authorities per group of 10 teachers and the funding provided to schools, are detailed in the programme logic framework in Appendix G in the separate Technical Appendices document.

2. About the evaluation

2.1 Aims of the evaluation

The evaluation covered the first three years of delivery of the Mathematics Specialist Teacher ('MaST') Programme, focussing on the experiences of Cohorts 1 and 2 of the programme. The aim of the research was to provide robust, independent evidence encompassing five strands of activity as set out below.

Strand 1: Development and delivery of the programme

This included exploration of:

- the effectiveness of the delivery model for the national programme
- the role of key stakeholders in this delivery e.g. HEIs, local authorities/local consultants, schools.

Strand 2: MaSTs' experiences of the programme

This included exploration of:

- the time spent by Mathematics Specialist Teachers ('MaSTs') on the programme
- MaSTs' views on the different components of the programme.

Strand 3: Impacts of the programme

This included exploration of:

- the impact of the programme on teacher subject knowledge, subject-specific pedagogy and collaborative working
- the impact of the programme on standards of teaching and learning and on whole-school improvement
- the impact on local authorities' provision and support for primary mathematics teaching
- the impact on teachers' attitudes towards learning and teaching mathematics.

Strand 4: Value for money

Evidence from Strands 1, 2 and 3 have been brought together in an overarching analysis of the delivery and impact of the programme. This incorporates economic assessment of the direct programme costs and indirect costs, compared against a complete assessment of key direct and indirect benefits, estimated in monetary terms.

Strand 5: Legacy of the programme

This included exploration of:

- research participants' views on the likely longer term impacts of the programme.

2.2 Methodology

The methodology comprised a multi-faceted approach, namely: large-scale surveys, involving a comparison group of schools; analysis of secondary data (again with a comparative focus); case studies; and a rigorous value for money element.

Below we outline the methodology in greater detail, namely:

- surveys and sampling procedures
- school case studies
- interviews with HEI representatives
- surveys and interviews with local consultants
- assessment of Value for Money
- National Pupil Database (NPD) modelling.

2.2.1 Surveys and sampling procedures

The first stage of the project involved **identifying a comparison group of schools**. Using data held on the NFER Register of Schools (RoS), which holds up-to-date information about each school in England, including information such as size, governance and pupil attainment, a comparison group of 1600 schools was selected. The comparison group was broadly similar to the MaST schools in terms of size, geography, attainment, and eligibility for free school meals (FSM). The creation of this comparison group

was integral to assessing the additionality of changes observed within MaST schools and deriving value for money estimates. The creation of the comparison group allowed relative performance of MaST schools to be compared with similar schools using survey data.

To capture the impacts of the programme on Cohort 2 MaSTs and their schools, **baseline, midpoint and endpoint surveys** were conducted in January 2011, September 2011 and June 2012 respectively with:

- headteachers in Cohort 2 MaST schools
- Cohort 2 MaSTs and comparison teachers.

In addition, baseline and endpoint surveys were administered to pupils in Key Stage 1 and Key Stage 2 in both MaST and comparison schools in September 2011 and June 2012 respectively. The pupil surveys were designed to capture pupils' general attitudes towards mathematics and their views on, and experiences of, their mathematics lessons.

Due to the timing of the evaluation, it was not possible to conduct a baseline survey of Cohort 1 MaSTs and so a **one-off survey** was undertaken instead. This was conducted in June 2011 with Cohort 1 MaSTs. A comparison group was not used for this survey.

In order to provide the most complete picture of the impact of the mathematics specialist role, the findings from the baseline and endpoint surveys undertaken with Cohort 2 MaSTs form the central source of survey data presented in this report. Findings from the Cohort 1 MaST survey were broadly similar across all questions to those of the Cohort 2 endpoint survey. They were reported in an earlier report and are not reported separately here.

Survey administration

Headteachers from the comparison schools were asked to identify a mathematics coordinator, or an experienced teacher of mathematics, to undertake the survey in January 2011. These comparison teachers were asked the same questions as the MaSTs across areas such as assessing their own mathematical subject knowledge, pedagogy and collaborative working and school-related contextual data. This allowed for the comparison of responses over time between the MaSTs and comparison teachers, with a particular focus on differences in distance travelled from the baseline position.

The MaST teacher surveys explored such areas as motivations for taking part in the programme, early experiences of the programme, and MaSTs' assessment of their own mathematical subject knowledge, pedagogy and collaborative working. Contextual data on the MaST teacher's school and experiences of other CPD were also gathered. The headteacher surveys explored similar areas, but did not ask headteachers to provide an assessment of the individual MaST teacher's subject knowledge, pedagogy or collaborative working.

The response rates to the staff surveys are shown in Table 2.1. Good response rates were received from MaSTs and headteachers across all four surveys (37 to 39 per cent, against a target for each survey of 28 per cent), suggesting considerable buy-in on the part of MaST Programme participants. The response from comparison teachers was predictably lower, reflecting that these teachers had no association with the MaST Programme and were not benefiting from its impacts. Table 2.1 shows the number of surveys sent and responses received, across the various survey instruments.

Table 2.1 Staff survey response rates

Cohort	Survey	Headteachers			MaSTs			Comparison teachers		
		Surveys sent	Responses received	Response rate	Surveys sent	Responses received	Response rate	Surveys sent	Responses received	Response rate
		(n)	(n)	(%)	(n)	(n)	(%)	(n)	(n)	(%)
1	One-off (June 2011)	-	-	-	1215	468	39	-	-	-
2	Baseline (January 2011)	1125	480	43	1133	415	37	1450	203	14
	Midpoint (September 2011)	1017	385	38	1021	392	38	1247	289	23
	Endpoint (June 2012)	877	399	45	877	324	37	1165	240	21

In September 2011, NFER distributed a baseline survey to pupils in Cohort 2 MaST schools and to pupils from a group of comparison schools. The response rates to the pupil surveys are shown in Table 2.2 below. Two age-specific surveys were administered to Key Stage 1 and Key Stage 2 pupils. The surveys explored pupils' attitudes towards mathematics lessons. We distributed the same surveys again to pupils in both MaST and comparison schools in June 2012.

Table 2.2 Pupil survey response rates

Cohort	Survey	MaST schools						Comparison schools					
		Key Stage 1			Key Stage 2			Key Stage 1			Key Stage 2		
		Surveys sent (n)	Responses received (n)	Response rate (%)	Surveys sent (n)	Responses received (n)	Response rate (%)	Surveys sent (n)	Responses received (n)	Response rate (%)	Surveys sent (n)	Responses received (n)	Response rate (%)
2	Baseline (September 2011)	1,256	1,037	83	3,558	3,077	86	525	475	90	2,080	1,758	85
	Endpoint (June 2012)	1,446	1,075	74	3,974	2,735	69	620	497	80	2,224	1,529	69

2.2.2 School case studies

In order to gather a more in-depth understanding of the implementation and impact of the MaST Programme, three rounds of teacher/school case-studies were undertaken. These included a one-off visit to ten Cohort 1 MaST schools between September and October 2011, a baseline visit to 11 Cohort 2 MaST schools between March and May 2011, and return ('endpoint') visits to ten of the Cohort 2 schools between June and July 2012. Three of the Cohort 2 schools had to be substituted for the endpoint visits owing to their MaSTs going on maternity leave. A total of 31 contacts with schools were undertaken, with a total of 24 different schools being involved in the case-study phase of the evaluation.

The case-study schools were identified using data collected from the MaST (teacher) survey. A range of responses to the final open-ended question in the survey (which asked about future plans for the programme) was sought, with a view to including in the sample a mixture of teachers (both those with well-defined, school-wide plans for the programme, and those with more modest or less clear plans). At least one school from each of the eight HEI/HEI consortia areas was included in the both the Cohort 1 and Cohort 2 samples. The schools also presented a diverse geographical spread, as well as diversity in terms of size and attainment. Selected characteristics of the 24 case-study schools are presented in Table 2.3. To preserve the anonymity of the case-study schools the schools are numbered rather than named.

29 of the 31 case studies involved a visit to the school, while two were conducted by telephone¹⁰. The case studies consisted of qualitative interviews with the MaST and the headteacher from each school (see box below for a brief explanation of qualitative research approaches). Additionally, MaSTs were asked to identify other stakeholders who might be able to provide further insight into the operation of the MaST Programme. Such stakeholders included local consultants who had worked closely with the MaST, other members of school staff who had worked with the MaSTs on programme-related activities and small groups of pupils who had undertaken activities or lessons that had been inspired by the programme. The number of different people interviewed in each case-study school is presented in Table 2.4

¹⁰ For most of the case studies where a local authority consultant was interviewed, these discussions were undertaken by telephone, although in one instance a face-to-face interview was arranged as part of the school visit.

Table 2.3 Characteristics of the 24 schools involved in the case-study phase of the evaluation

Cohort	School	School type	Age range	Number on roll	% SEN (with statements or on School Action Plus)	% FSM	% achieving Level 4 or above in English and Mathematics at Key Stage 2 (2011)
1	1.	Community	4-11	170	9.6	11.4	88.0
	2.	Community	7-11	240	9.9	7.8	75.0
	3.	Voluntary controlled	4-11	420	N/A	N/A	N/A
	4.	Community	3-11	190	17.6	46.0	81.0
	5.	Voluntary Aided	4-11	90	4.7	3.5	89.0
	6.	Community	3-11	480	9.6	42.2	76.0
	7.	Community	3-11	300	17.2	27.6	81.0
	8.	Community	5-11	200	1.9	2.6	92.0
	9.	Voluntary Controlled	5-11	80	3.6	3.6	100.0
	10.	Community	5-11	250	18.5	32.9	68.0
2	11.	Voluntary Aided	4-11	85	3.5	5.9	91.0
	12.	Voluntary Controlled	7-11	295	5.1	8.2	90.0

13.	Community	3-11	440	3.2	22.2	82.0
14.	Voluntary Controlled	4-11	210	3.3	2.4	93.0
15.	Community	4-11	230	12.1	29.4	86.0
16.	Community	9-13	320	8.5	23.3	67.0
17.	Voluntary Aided	5-9	300	3.0	4.0	N/A
18.	Community	3-7	230	5.2	13.9	N/A
19.	Voluntary Aided	5-11	460	2.6	43.2	49.0
20.	Voluntary Aided	4-11	300	2.6	14.1	91.0
21.	Voluntary Controlled	5-11	190	5.9	3.2	50.0
22.	Voluntary Controlled	5-9	90	11.0	3.4	N/A
23.	Voluntary Aided	4-11	80	11.8	5.3	63.0
24.	Community	3-11	470	7.9	4.1	88.0

Source: NFER evaluation of the MaST Programme, 2011-2012

Table 2.4 The different people consulted in each of the 24 schools involved in the evaluation

Cohort	School	Senior leader	MaST	Other teacher	Local Authority	No. of pupils consulted in different year groups				
						Y1	Y2	Y4	Y5	Y6
1	1.	1	1	1	0	0	0	0	0	6
	2.	1	1	1	0	0	0	0	0	0
	3.	1	1	2	1	0	0	0	6	0
	4.	1	1	1	0	0	0	0	5	0
	5.	1	2	0	1	0	0	0	0	0
	6.	1	1	1	1	0	0	0	0	0
	7.	1	1	3	0	0	0	5	0	0
	8.	1	1	1	1	0	0	1	1	0
	9.	1	1	1	0	0	0	0	2	0
	10.	1	1	1	1	0	0	0	0	0
2	11.	1	1	1	1	4	2	0	0	0
	12.	1	1	1	1	0	0	5	0	5

13.	1	1	1	1	0	0	0	5	0
14.	1	1	0	1	0	6	0	0	0
15.	1	1	1	0	0	0	6	0	0
16.	1	1	1	1	0	0	0	0	6
17.	1	1	0	1	0	0	0	0	0
18.	1	1	2	0	0	2	0	0	0
19.	1	1	0	1	0	0	0	0	0
20.	1	1	0	0	0	0	0	5	0
21.	1	1	1	1	0	0	0	4	0
22.	1	1	1	1	0	0	0	0	0
23.	1	1	1	0	0	0	0	0	4
24.	1	1	1	1	0	0	0	0	0

Source: NFER evaluation of the MaST Programme, 2011-2012

A note on qualitative research and reporting

'Not everything that can be counted counts, and not everything that counts can be counted'

(attributed to Albert Einstein).

Qualitative research traditions provide a means for tackling complex questions exploring 'how', 'why', and 'what if'. Qualitative research is not intended to provide a basis for generalisation. It is instead about improving understanding of – sometimes quite subtly – the distinctive nature of people's experiences and outlooks. So, whilst research participants could be chosen using random sampling approaches, it is more common for them to be chosen purposively, often from information which can help ensure a range of perspectives.

The principal qualitative method is the semi-structured interview, where interviewers use a 'topic guide' to keep the conversation going and on track, but continuously adjust, re-order and add to the questions in the guide, to take account of what the interviewee is saying and offer them a more tailored and meaningful experience. This has been the method employed by NFER researchers in conducting qualitative interviews as part of the MaST evaluation. This approach allows research participants, who are often in a better position than researchers to identify what is really important, some influence over the direction of the interview and ultimately the findings of research.

Qualitative data takes the form of detailed notes and sometimes a verbatim record of the conversations which have taken place. This means one interview can provide pages and pages of data which offers rich insights on the experiences and perspective of the interviewee, but can be time-consuming to properly analyse. As a result, qualitative research projects generally involve relatively small numbers of participants. This in itself would make keeping a 'tally' of opinions or perspectives (e.g. 'four of the interviewed MaSTs reported...') of doubtful value. Another issue here is the non-standardised nature of interviews – there is no way to be sure that if a question had been framed slightly differently or asked at a different point, whether the same response would not have been given by other interviewees.

Qualitative analysis and reporting therefore focuses not on the quantification of perspectives, but on distilling out, and illustrating, the range of issues or themes. This can serve a range of functions – in this particular report the qualitative material firstly adds colour and context to the quantitative material, and secondly poses questions about some programme assumptions which might usefully be explored further in subsequent phases of the research.

2.2.3 Interviews with HEI representatives

Qualitative interviews were conducted with representatives from all of the HEIs delivering the MaST Programme at three time points: during late 2010, late 2011 and mid 2012. Telephone interviews were conducted with HEI representatives, with at least one interview, and in most cases two, being undertaken at each time point with a representative from each of the eight HEIs leading the delivery of the MaST Programme.

The interviews covered such areas as:

- programme development and management and delivery
- progress to date
- aspects of the programme working well, or posing particular challenges
- impacts
- sustainability.

2.2.4 Surveys and interviews with local consultants

Local authority staff and independent consultants located within the 120 local authority areas delivering the Cohort 2 MaST Programme were invited to respond to an email survey during early 2011, late 2011, and mid 2012. A total of 150 completed surveys were returned overall (70 in December 2010/January 2011; 48 in December 2011/January 2012; and 21 in August/September 2012).

The survey enabled local consultants to fill in open-response boxes within a Microsoft Word document. A number of the responses received were either explicitly a local authority-wide response, naming a number of contributors, or implied that a number of people had contributed.

The local consultant proformas covered such areas as:

- staffing
- how the MaST Programme fitted within the local authority's existing provision
- relationships with HEIs
- the operation of the MaST Programme within the authority
- aspects of the programme working well, or posing particular challenges
- impacts arising for teachers and schools
- sustainability.

In order to provide further richness to the information received through the local consultant surveys, brief telephone discussions were undertaken with 10 of the local authority staff responding to the survey. These discussions were informed by the previous survey responses and probed further into areas of particular interest, such as emerging programme impacts.

2.2.5 Assessment of Value for Money

The report includes a description of the delivery costs for Cohort 1 and 2 of the MaST Programme compared against an assessment of the benefits. Using data on costs, activity and immediate outputs from the programme, estimates of the economy and efficiency of the MaST Programme are provided. The findings are presented in Chapter 6.

2.2.6 National Pupil Database (NPD) modelling

Statistical analysis has been undertaken to explore whether there is any emerging evidence that participation in the MaST Programme has improved the attainment of year 6 (Key Stage 2) and year 2 (Key Stage 1) pupils, relative to the progress of pupils in the group of comparison schools. Specifically, two forms of analysis have been undertaken: multilevel modelling; and propensity score matching. The findings are presented in Section 5.4.1 and a full explanation of the analyses undertaken can be found in the technical appendices.

2.3 Focus of the report

This report draws together all of the data that has been collected during the course of the evaluation. This includes data collected from HEI and local authority deliverers, surveys of MaSTs and comparison teachers, surveys of pupils and school case studies. In relation to the surveys, the focus is primarily on the baseline and endpoint surveys that were conducted with Cohort 2 teachers and a comparison group of teachers and their pupils in addition to Cohort 2 headteachers. The data that was collected from the Cohort 1 teachers' snapshot survey was broadly similar to that collected at endpoint for Cohort 2 teachers so it is not reported separately here. The report also includes data from the case-study visits undertaken with Cohort 1 and 2 MaSTs. Additionally, it includes an analysis of NPD modelling and the analysis of value for money.

2.4 Analysis and reporting

The report is structured as follows:

- Chapter 3 explores the development and delivery of the MaST Programme;
- Chapter 4 explores MaSTs' experiences of the programme
- Chapter 5 looks at the impacts of MaST Programme
- Chapter 6 presents the findings from the value for money analysis
- Chapter 7 explores respondents' views on the sustainability and legacy of the programme.

The concluding chapter draws together the key messages from the different strands of the evaluation, provides a final assessment of the effectiveness of the MaST Programme and presents recommendations for policy and practice.

Findings from descriptive analysis are reported within the chapters. The main variables discussed throughout relate to the type of respondent and the observed differences between responses from MaST and comparison school respondents. Statistical significance tests were conducted on selected questions and are reported where relevant.

Key findings are summarised at the beginning of each of the chapters.

3. Development and delivery of the MaST Programme

Key findings

- The MaST Programme has been, and continues to be, **effectively managed and delivered** despite changes in government policy, which have impacted on funding for supply cover, and staffing challenges resulting from redundancies and changes of staff roles within local authorities. In most cases, effective solutions have been found and any possible disruption for MaSTs has been minimised.
- The **strong partnerships that have developed between HEI staff and local consultants are impressive** with both parties bringing complementary skills and expertise to the programme.
- The **content and delivery of the MaST Programme is considered to be 'spot on'**. This includes its focus on the development of mathematical subject knowledge, pedagogical knowledge/skills and teachers working with colleagues to impact on standards of mathematics teaching across the school, in addition to its combination of academic challenge and rigour and practical application of learning in the classroom.
- The **programme components are well integrated** with the HEI sessions and local network meetings complementing and leading on from each other. Teachers have benefited immensely from the networking opportunities provided in both of these forums and the cohesive and supportive networks that have developed at a local level.
- **A challenge experienced by some MaSTs has been a lack of active senior leadership support** which has limited their ability to impact at a whole school level. In most cases, this has been due to competing priorities or changes in staff. However, in the vast majority of cases, headteachers have been very supportive of their MaST.
- Being a Masters level course, **the MaST Programme is very demanding and teachers have had to adjust to the academic study and writing**. Time has also been an issue for teachers in terms of the collaborative working with colleagues element. However,

the majority of MaSTs have managed the programme well and, in the main, drop-outs have related to changes in teachers' personal circumstances (with maternity leave being a key reason) as opposed to the demands of the course.

3.1 Introduction

The data for this chapter comes from interviews undertaken at three time points with staff delivering the programme within the eight HEIs, or HEI consortia, and with their local authority and freelance consultant partners (see Table 3.1 below). The interviews and proformas explored programme management, content and delivery, what was working well, what challenges were being faced and impacts. Over time, more focus was placed on longer-term impacts and sustainability. Data from the questions on impacts is reported in chapter 5.

Table 3.1 HEI and local authority consultees

	Dec 2010/ Jan 2011	Dec 2011/ Jan 2012	Aug 2012/ Sept 2012
HEI interviews	17	18	17
Local consultant completed surveys	70	48	32
Local authority interviews	10	-	-

Source: Evaluation of MaST Programme, 2010-12, NFER

3.2 Programme management and staffing

The **overall responsibility for the management, planning and delivery of the MaST Programme has lain with eight lead HEIs**. In four cases the programme has been developed and delivered by a lead HEI within a consortium of HEIs (ranging from two to five HEIs).

HEIs have worked with local authority staff in their delivery of the programme and **the input of local authority staff has been very important**. In some cases, local authority staff have been involved at the overall programme level in terms of agreeing the aims, structure and ways of working and planning the content. This has particularly been the case for local authority staff involved in the Pathfinder stages of the programme. In other cases, their involvement has primarily related to the planning of the content for, and the delivery of, the local network meetings.

In many cases, HEIs have continued to work with their link local authorities for the duration of Cohort 1 and 2. However, the delivery of the MaST Programme has been affected by redundancies of mathematics consultants in local authorities, or changes in consultants' role to a more generalist function. **Despite these changes, continuity and high quality in programme delivery has been maintained in the vast majority of areas.**

- HEIs have been creative in their staffing solutions, and where they have faced redundancies in mathematics consultants in their local authorities, they have often continued to work with these staff as freelance consultants or by employing them. In some cases, consultants have taken on larger geographical areas which has provided more flexibility to HEIs but has involved consultants in a steep learning curve in terms of building relationships with schools they had not previously worked with. There are also examples of consultants who, after redundancy, have returned to schools in senior roles but have maintained their role as mathematics consultants within the MaST Programme due to their commitment to the programme. So, despite staffing changes and losses in local authorities, in most cases, effective solutions have been found and the MaST Programme has continued to be delivered in much the same way, with the same people, as the following quotes exemplify:

Because I was leading on the MaST Programme in [area] prior to redundancy from the LA in March 2011, how I deliver the programme networks has remained the same – in the teacher's school, in similar size groups...Because I am now working with the third cohort I feel increasingly confident with the content and main messages – the continuity of my work was very much welcomed by the schools and teachers following March 2011.

(Independent mathematics consultant)

...we have been able to keep it really quite seamless for the students.

(HEI consultee)

Particularly in the early stages of the programme, local authority consultants spent much more time on the programme than they were funded for in order to ensure its effective delivery and the integration of its various components. As well as spending additional, unfunded time preparing for local network meetings and adapting materials, many local authority consultants attended the HEI days in their own time due to the value they perceived that their attendance would bring to the overall programme. As two consultees commented:

All bar one of the local authority consultants have attended the HEI days on Saturdays in their own time and all bar two have attended all of them. They are incredibly dedicated and there is a lot of goodwill and professional desire to understand the content. I am so impressed. There is a huge amount of goodwill and a high level of professionalism that they are giving.

(HEI consultee)

It gives a message about a joined up partnership and ensures continuity in the programme.

(Local authority consultant)

In addition, many local authority consultants have spent a fairly significant time in schools meeting with headteachers and supporting MaSTs over and above what has been paid for by the MaST Programme. This additional work in schools, undertaken as part of local authority consultants' whole school improvement role, has been particularly instrumental in supporting less experienced teachers to impact at a whole-school level.

However, the changes in local authority staffing, and increased emphasis of some local authorities on full-cost recovery, have, in some cases, impacted on the additional, non-costed time that local consultants have been able to put into the programme. As two mathematics consultants (now independent) commented:

Because the work is now funded by the HEI per day, there is no funding for recruitment, attendance at residentials (which I believe is important to the working relationship with the teachers), administration or travel (significant in a large authority). Whilst working for the LA all these would have been part of my job and travel would have been paid.

(Independent mathematics consultant)

...payment is made solely in respect of planning and delivering the half-termly network meetings – no travel time is included, or cost of

materials used for the network meetings, or extra time with emails, phone calls and occasional meetings to support the teachers involved. Whilst supporting Cohort 1, I attended all of the HEI sessions and residential, which I felt I could do because I was in full-time employment with the LA, now, as an independent adviser working with the university, I still feel this is important, however all of the additional time and travel will be at my own personal expense...

(Independent mathematics consultant)

3.3 Programme content and delivery

3.3.1 The overall programme

The MaST Programme includes the following components:

- **five HEI days a year** (run on a Saturday and via an Easter residential school) in which teachers meet in large groups across local authorities
- **six local half-day network meetings a year** delivered by local consultants in which teachers meet in groups of ten within their local authority area (or in some cases, more recently, teachers have been combined across local authority areas or a region as a result of local authority redundancies)
- **readings and materials made accessible by the HEIs** via websites/virtual learning environment (VLE)/blackboard and links made to other useful websites such as that of the National Centre for Excellence in the Teaching of Mathematics (NCETM)
- **teachers' access to a personal tutor from the HEI** who can support their academic progress and their work on assignments
- **a half-day annual visit to schools by the local consultant and/or HEI staff** to meet with the headteacher and MaST.

In addition, teachers are expected to undertake 11 days (66 hours) annually of in-school classroom focused work and work alongside colleagues, as well as 83 hours of self-supported study.

Teachers have also been required to complete a **learning log** which acts as a bridge between the HEI days and local network meetings in which teachers record their actions and reflections between sessions. Between sessions, MaSTs have been asked to undertake a variety of activities such as read research papers or reports, undertake a mathematics problem or exercise, or undertake an activity with

colleagues in school. These activities have served to further link together the various sessions and maintain continuity in the programme. The content of teachers' learning logs has been used and discussed in local network meetings and within the assessment process. There has also been some use of online tutorials and discussions.

The MaST Programme comprises three key strands which include the development of: subject knowledge, pedagogical knowledge and working with colleagues. Most HEI and local authority consultees have commented that a key strength of the programme has been its focus on mathematics subject knowledge content. However, a small number of consultees have suggested that the programme would benefit from an additional focus on leadership and action planning although others have emphasised that they would not want the focus on mathematics subject knowledge to be diluted.

In general, both HEI days and local network meetings have been structured around the three key strands of the programme. However, in some cases, the focus of the HEI days has been on developing subject knowledge, with the focus of the local network meetings being more on pedagogies and collaborative working with colleagues. HEI sessions and local network meetings have covered both areas of mathematics content (such as measures, shape, time, division and fractions), as well as pedagogy and the effective use of different resources (such as mathematics talk and using models and images). In addition, teachers have explored progression in mathematics from the early years through the primary phase (for example the principles of counting through the age ranges) and pupil misconceptions. Either through the 'big ideas' approach (see below) or through a focus on the seven strands of the primary mathematics curriculum, the programme covers all areas of the primary curriculum by the end of the second year.

As the programme has progressed and teachers have become more secure in their subject knowledge and use of new teaching approaches, **more focus has been placed on collaborative working with colleagues.** Although this element is covered from the start, in year 2 there has been increasing emphasis on working with colleagues, on mentoring and coaching, and on approaches to supporting colleagues, such as lesson study, as this interviewee indicated:

There's also the working with colleagues, the other part of the programme right the way through from the beginning, the emphasis and the importance of it becomes greater and the impact becomes greater in the second year.

(HEI consultee)

Some HEIs, though, have placed a strong emphasis on the working with colleagues strand from the start, for example by asking teachers to undertake tasks with two age groups, not just the age group that they currently teach. Others have increased their focus on MaSTs' collaborative working with their colleagues in the first year of the programme for Cohort 2 as a result of evaluation feedback from Cohort 1.

In terms of assessment, most HEIs have set teachers one assignment per year. However, some have set two assignments in year one and one or two in year two. There has also been some focus on an ongoing assessment of teachers' contribution to discussions at HEI days.

In relation to the differences between the level and content of the HEI days and the local network meetings, consultees have described the HEI days as:

- being more complex and challenging for teachers (they 'take the content deeper' and 'raise the bar')
- including more theory (for example, focusing on how children learn)
- including more information and support on the academic study side (e.g. on the assignments, assessment process and use of the library)
- focusing more on the type of writing that is needed, conceptual ideas, critical reading of papers and up-to-date research evidence.

Although HEI days have usually included a practical element and mathematics exploration, **local authority sessions have tended to be much more practical and hands-on, focusing more on teachers' assessment of their own skills and the practical application of learning in teachers' own classrooms.** Some have also included the exploration of more 'straightforward' research.

In many cases, the programme materials that HEIs have developed in conjunction with local consultants are bespoke and this has particularly been the case for year 2 of the programme. However, in some cases, tried and tested materials from other courses have been adapted for use in the programme. This has included the MaST Pathfinder materials (frequently used where HEI staff were involved in the Pathfinder), as well as National Strategies and NCETM materials, and materials used in other HEI courses and within the local authority. Considerable time has been invested by HEIs and local authorities to create the content of the programme.

Over the course of the programme, the HEIs and local consultants have collected evaluation data from teachers on both the HEI days and local network meetings and, in their role as overall programme managers, the HEIs have also completed an end of year review. They have made ongoing small adjustments and enhancements to the programme in response to this feedback but, generally, the

content of the programme, as it was originally set out by HEIs has largely remained unchanged:

...So I would say that what we've done is largely refine and improve rather than make any wholesale changes...

(HEI consultee)

The most common changes that have been made include: an increase in focus on mentoring and coaching to support collaborative work with teachers; increased support to teachers in their writing of assignments at level 7 (Masters level); earlier and more discussions with headteachers regarding the need for the MaST to undertake whole school CPD activities in year two; increasing the focus on the school visit and/or bringing headteachers together to discuss whole school improvement; and building in activities relating to the new mathematics curriculum and to changes in the Ofsted framework.

The delivery of the MaST Programme has been impacted by the reductions in funding to pay for supply time to support MaSTs to work collaboratively with their colleagues in schools and to allow MaSTs time out of the classroom to attend in-school meetings with programme deliverers. The impacts of these changes are discussed in the following sections.

3.3.2 Local network meetings

During the course of the programme, HEIs have met with local consultants in planning meetings once or twice a term to provide direction and content for the upcoming local network meetings. At planning meetings, local consultants have fed back on previous local network meetings, HEI staff have provided an overview of the next HEI day, and subsequent local network meetings have been planned.

During the planning meetings, HEIs have consulted local consultants regarding the materials that they have developed for the local network meetings. Most local consultants have been happy with the way that their link HEI has involved them in developing and enhancing the materials and many consultants have adapted the materials to meet the needs of their particular groups of teachers. As two local authority consultants commented: 'We meet to plan each network meeting and the sharing of resources has been a two-way process. We learn from each other' and '[the] HEI listens to my thoughts and is happy to amend the resources over time while still maintaining the integrity of the programme'. One HEI interviewee noted that, since commencing Cohort 2 of the programme, the increase in local consultants' familiarity with the programme had led to them being able to contribute much more proactively to the planning process. Similarly, a number of HEI

interviewees and local authority staff noted that planning and meeting together had become smoother as the different parties got to know each other.

However, a small number of local authority consultants, including a number linked to one particular HEI, expressed some initial frustration at the system for planning the locally delivered elements, reporting that there had been limited or no scope for input from local authority consultants. One of these consultants commented: 'We are merely being asked to deliver parts of a pre-existing programme; there is no input from us in terms of planning the programme'.

In the early stages of the programme, local consultants spent between half a day and a day preparing for each local network meeting. This time was spent familiarising themselves with the materials and adapting them for use with their teacher group, as well as drawing on other appropriate resources and materials and undertaking any necessary reading. Some of this preparation was over and above that paid for by the programme but was seen as a necessary part of the role, as one local authority consultee commented: 'The time allocated to the programme is not enough for the preparation, but it is part of the consultant's job to support schools so this time gets subsumed within the job of consultant'. As local consultants became more familiar with the content and delivery of the programme, this time reduced, and this was particularly the case in relation to Cohort 2.

Typically, ten teachers have gathered at the local network meetings which have offered them the potential for small group and individualised support at a local level. In some local authority areas, the meetings have been held in local schools as opposed to within local authority premises or run by HEI staff where a local consultant is no longer available. One HEI invited headteachers to the meetings in the second year of the programme to increase their support for their MaST.

In one HEI area, from the outset, the local network meetings have been run as action learning sets to support deep reflection and analysis and the sharing of learning. Initially, this approach involved local authority consultants and teachers in a steep learning curve as most had not been used to asking searching open questions, as distinct from offering solutions. To ensure a clear focus, over time the action learning was directed more. This included: reading materials being provided to teachers in advance of sessions for them to reflect on and be ready to discuss; teachers being asked to read out an excerpt from their learning log for discussion or to reflect on what was happening in their classroom; and teachers undertaking a mathematical activity at their own level. This approach proved very effective as consultants and teachers developed expertise in using it. In a similar vein, in another area, over time the meetings shifted from a 'training' approach to 'collegiate development', with MaSTs being valued for their insights in supporting their colleagues within a cohesive group environment.

In three HEI areas, some changes were made to the delivery of the local network meetings for Cohort 2. In one area, the half day sessions were delivered as twilight sessions rather than afternoon sessions and, in two others, the two half termly meetings were replaced by one full day meeting a term which reduced teachers' travel time. In the third HEI area, there was a change in both the timing and delivery of the meetings with the two meetings per term being replaced by one full day meeting a term led and delivered by the HEI staff. This change was partly as a result of mathematics consultant redundancies but also related to feedback from MaSTs that they wanted more contact with HEI staff in year 2. In some areas, MaSTs were brought together in regional groupings or in mixed local authority groupings.

In most cases, these changes were positive and did not impact on the effectiveness of programme delivery. However, some minor drawbacks were noted by local consultants. For example, teachers had already worked a full day when they attended twilight sessions and one full day a term rather than two half days reduced the frequency of contact that programme delivery staff had with their MaSTs. In addition, in the HEI area where the meetings were run by the HEI within two regional groupings, it was felt that teachers lost the local, supportive network that developed when the local network meetings were delivered in local authority areas. However, to counterbalance this, the groupings across local authority areas have allowed a 'wide range of experience, responsibilities and opinion' (Local authority consultant) to be drawn upon in discussions.

The following comments from three local authority consultants working with different HEIs sum up the views of the majority of local consultants who have contributed to the evaluation:

The network meetings are a particularly effective aspect of the programme. They are always well evaluated by the teachers who have identified them as particularly effective in their development. The meetings continually evolve as part of the regular dialogue between LA and HEI as a result of feedback from teachers and evidence gained through school visits.

(Local authority consultant)

The participants embrace the opportunity to work together sharing expertise, reflecting on practice and extending subject knowledge... There is a good balance of practical activities, opportunities for discussion and time for reflection. The LA sessions feed in to the HEI sessions and provide preparation for assignments to be submitted for the programme. Feedback from the participants following the meetings

is always extremely positive, highlighting the supportive and collaborative nature of the sessions.

(Local authority consultant)

In some cases, MaSTs have set up Facebook groups and have met locally outside of the course, for example when writing their assignment and this peer support and sharing of ideas, learning and good practice has been very effective.

3.3.3 The half-day school visits

The half-day visits to schools in which meetings are held with the MaST and the headteacher are seen as an invaluable aspect of the programme.

This is in terms of:

- engaging the headteacher in the MaST Programme and keeping the expertise of the MaST and the need to support him/her at the forefront of their mind
- providing the headteacher with feedback as to how the MaST is doing and exploring the impacts of the programme on the school
- sharing best practice from other schools
- assessing the teacher's progress and providing one-to-one support/tutoring/coaching, as needed
- planning the teacher's future collaborative activities in school, discussing and overcoming any barriers and broadening the scope and scale of the MaST's work as far as possible and ensuring that impacts continue post-MaST.

As one consultee commented:

...these meetings are really important and they do flag up concerns and where things are working well. It has sometimes resulted in the headteacher wanting the participant to share more stuff at staff meetings or other opportunities with the staff when they realise just the extent of what they [the MaST] have been doing and it also flags up if the participant hasn't been doing anything

(HEI consultee)

In most cases, consultants have not experienced difficulties in arranging and undertaking the individual visits despite the fact that funding for supply cover in schools was withdrawn for Cohort 2 and year 2 of Cohort 1. Moreover, in some cases, local consultants have had more regular contact with their schools over and above the half day visits.

The half-day school visits have often included an observation of the MaST teaching a mathematics lesson and individual tutoring of the MaST as well as meetings with the MaST and headteacher. In some cases, the consultant and MaST have co-delivered a lesson and used this as a lesson study. HEIs have evaluated the programme on an ongoing basis and, in many cases, the format and content of the meetings has been enhanced over time to ensure that the time in school is used as effectively as possible. Some HEIs devised a series of notes and/or a proforma, or series of key questions, to guide the discussion in school and the agreement of future actions. Over time, this has been an area of the programme on which HEIs have focused more attention to ensure that the visits achieve the best possible outcomes and that headteacher commitment to the programme is secured and sustained.

However, **in some areas, the withdrawal of funding for supply cover for the school visits has meant that not all schools have taken up this opportunity which means that local consultants and HEI staff have found it more difficult to monitor progress in these schools**, particularly in terms of the MaST's collaborative working with other teachers and impacts on whole school improvement. Several HEI consultees have suggested that the half-day visits to schools should be compulsory and something that headteachers commit to when their MaST starts the programme.

In one HEI area, the meetings at individual schools have been replaced by group meetings of headteachers and their MaSTs. The headteachers undertake a MaST-type activity and, in so doing, they gain an understanding of what the programme entails. In terms of sharing best practice between headteachers and encouraging headteachers to emulate what is working well in other schools, this approach has proved effective and encouraging headteachers to put in place actions to support MaSTs within their schools. However, local consultants have commented that the meetings have provided less opportunity for the in-depth exploration and development of actions for individual schools and for the provision of one-to-one support to the MaST.

3.3.4 The delivery of HEI sessions

For Cohorts 1 and 2, the delivery of the HEI sessions has remained the same for most HEIs as it was set out at the beginning of the programme with five face-to-face sessions being delivered in each year of the programme. The exception is one HEI which chose to deliver face-to-face HEI sessions just in the first year of the programme because the course was designed more as an open learning programme with MaSTs completing nine units of work each year with access to detailed materials online and a personal tutor. However, tweaks and enhancements have

been made to content and delivery on an ongoing basis in response to evaluation feedback. As two HEI consultees commented:

We are continually tweaking those and changing things slightly

(HEI consultee)

The programme is reviewed constantly in the light of feedback and evaluations, research perspectives, new initiatives and reflections on experience

(HEI consultee)

In most cases, the HEI face-to-face sessions have been linked to materials available on the university's virtual learning environment. For example, one institution has produced 'learning blocks' which have provided MaSTs with reading and tasks to undertake between HEI sessions and local network meetings and have prepared them for assessment, including timescales, guidance and templates.

A number of HEIs have chosen to focus on 'big ideas'¹¹ in the HEI sessions, which have a broad application across the primary mathematics curriculum and its various topics rather than focusing on a specific curriculum topic, and this approach is said to have proved very effective:

It has allowed them [teachers] to look at mathematics in a new way and re present it back in their school with a new light emphasising the right aspects of what it is to be mathematical

(HEI consultee)

It [the 'big ideas' approach] has stimulated real thought and provided real opportunities for development of depth of understanding

(HEI consultee)

Most HEIs have invited external keynote speakers with a practice focus and who are well known and respected within the primary mathematics community to facilitate sessions during the HEI day. The aim of these sessions, alongside other elements of the HEI days, has been to challenge teachers' thinking and to 'push them to the limits of their understanding'.

During the HEI days teachers have also had the opportunity to network with teachers outside of their authority and to share learning and experiences. In some cases,

¹¹ One HEI describes these as: mathematical thinking, representation, generality, pattern and proportionality which run through the programme.

HEIs have brought Cohort 1 and 2 or 1 and 3 MaSTs together so that those further on in the programme can support those in earlier stages.

Several HEIs have replaced the residential element with two full day sessions for Cohort 2 and/or 3 due to the high cost of running it, though the loss of the informal networking the residential element offers has been noted.

3.3.5 Programme integration

The HEI teams setting the direction of the programme have worked hard to ensure coherence between the HEI sessions and the local network meetings.

In most cases, they have developed an overall matrix for the programme which has ensured that all of the elements of the programme relate to, and build on, each other. The HEIs have introduced a topic which has then been followed up at the local network meeting. The network meetings have focused on how the learning can be translated into the classroom and have provided an opportunity for MaSTs to review the reading recommended at the HEI day.

Several consultees have commented very positively on the integration of the various programme elements:

The HEI sessions and the local network meetings complement each other very well and links between each of the components create a coherent structure for the teachers on the programme. Tasks set at HEI sessions are followed up and discussed at local network meetings and vice versa.

(Local authority consultant)

It feels a very well integrated programme and we have all taken great pains to ensure that that is the case... When a particular session needs to be delivered before a HEI day, we make sure that this is done. Sometimes the HEI day involves following something up and the whole day is worked out in advance.

(Local authority consultant)

It feels like a whole programme and the learning log supports the linkages between the sessions.

(HEI consultee)

The clear overall structure of the MaST Programme and the joint planning by HEIs and local consultants have supported its integration. Integration has also been supported by local authority staff putting significant unpaid time into the programme in preparing for local network meetings and attending HEI sessions, as mentioned previously.

However, a small number of local authority consultants identified that the lack of funding for their attendance at HEI sessions had created a potential challenge to the integration of the programme. These respondents felt that, without direct knowledge of what teachers were covering at these meetings, it was difficult to ensure the full integration of the programme. One such local authority consultant commented:

A challenge is ensuring as a local authority that the content and messages from the HEI days are known without having time factored in to attend these days. Building in the finances to ensure local authority consultants attend the HEI days would improve continuity between local meetings and help us understand questions that arise as a consequence of HEI days.

3.4 Overall what has worked well and why?

The **balance within the MaST Programme between academic learning and practical application has been very effective and** the vast majority of consultees have reported the effectiveness of the practical focus of the programme, as well as its integration of theory with practice:

They [teachers] like working on workshop sessions when they're looking at an aspect of mathematics or an aspect of pedagogy in a very practical hands-on way. Whether that's something to do with say, using stories in mathematics lessons or an aspect of pedagogy

(HEI consultee)

The programme has a good balance between theory and practice. Teachers are required to do considerable amounts of reading, but there are also classroom focused activities which make the link directly to their own teaching.

(Local authority consultant)

The MaST Programme seems to be one of the most powerful forms of CPD I've ever seen...it's made more changes to more people in terms of positively developing mathematics than anything I have ever seen

(Local authority consultant)

It is a strong delivery structure [the HEI/local authority partnership] which includes both theory and practice and reflection. It includes teachers developing their own subject knowledge and practice but also working collaboratively with other teachers to support their development.

(HEI consultee)

The programme's **focus on three key and significant areas to improve mathematics in schools - subject knowledge including progression across the Key Stages, pedagogy and collaborative working with colleagues - has also been very effective**, with one HEI consultee echoing the comments of others by describing the content as 'spot on'.

As part of the 'collaborative working with colleagues' element of the programme, the emphasis on **developing teachers' skills in mentoring and coaching, lesson study and subject leadership has also been effective in terms of impacts on whole school change**. This, combined with their increased knowledge of progression across the Key Stages, has provided MaSTs with the confidence and skills to work with teachers across their school and to overcome challenges that they might face:

I would say that one of the things that has been a real success of this as a course, complemented by the involvement of the local authority and they're running sessions as well, has been the emphasis on mentoring and actually looking at the skills of coaching and mentoring quite distinctly...they've had to develop resilience to the resistant points in the school culture.

(HEI consultee)

Consultees have also commented on **the effectiveness of the programme's combination of HEIs sessions and local network meetings**. The HEI sessions have challenged, stretched and inspired teachers in large groupings, whilst the local network meetings have allowed a focus on practical application of learning in the classroom and a local, cohesive support network of teachers to develop. MaSTs

have benefited from the networking opportunities provided by the both the HEI sessions and local network meetings which have allowed them to share learning and expertise:

...they love the opportunities to be able to work with each other and to get insights from each other's practice... it's much more convincing if somebody else says "I did this last week and it worked" than anything else. And that's the thing that's most likely to make you go and try it.

(HEI consultee)

The opportunities of more informal networking that the HEI-led Easter Schools have provided have 'really developed the capacity of MaSTs immensely' (HEI consultee) and one HEI which cut this element has now re-instated it in the programme due to the effectiveness of the networking 'over a glass of wine in the bar'.

The vast majority of consultees have agreed that **a key strength of the programme has been the HEI and local authority relationships** with local consultants being frequently glowing about the relationship, describing it as: 'good', 'very positive', 'great', 'strong', 'excellent', and 'very effective'. Both parties have treated each other with mutual respect and a 'high degree of trust' and have brought considerable and complementary skills, expertise, local knowledge and contacts to the partnership:

I think a major strength of the programme is the access it allows to quality CPD from eminent mathematicians

(Local authority consultant)

The majority of local consultants have been very positive about the way that the joint planning has worked describing the planning component as, for example, 'invaluable', 'effective', and 'very successful'. They have also reported that communication with HEIs has been good and responses to emails have been provided swiftly; HEI staff have been very supportive and helpful; resources are good; and they have been listened to and valued for their knowledge and expertise. Considering the scale of the partnership working involved in the programme, and the extent to which the MaST Programme represents a unique approach to delivering Masters-level CPD, **the effectiveness and relatively smooth operation of the HEI-local authority partnerships are impressive.**

Likewise, HEI staff have been frequently complimentary about local consultants reporting that **the knowledge and skills of local consultants and their links with local schools have greatly supported the development and planning of the programme.** In some cases, HEIs have learnt from the local authorities, for example

one local authority consultant showed staff in the link HEI how concept cartoons could be used. As several consultees have commented:

We feel that we have developed excellent working relationships with LA colleagues and benefit from their input into the planning and development of the programme... We feel we have a strong team committed to collegiate practice and that our particular expertise and complementary roles are recognised and valued by both sides

(HEI consultee)

The strong working relationship with the HEI leads has continued, and open and honest dialogue about 'what works well', and 'what can be improved further' is always on the agenda

(Local authority consultant)

It's the blend of academic and professional and the strength of the HEI/local authority partnership, the underpinning theory and pedagogy from the academic side and the practical support and delivery from the local authorities. The biggest benefit is the expertise of the academics and consultants

(HEI consultee)

The programme is really good and it needs all of the partners. The universities provide the academic rigour to it and local authorities have the stretch and contacts across the local region and you need both

(Local authority consultant)

A number of factors have been reported to contribute towards the development of an effective and productive working relationship between HEIs and local authorities. These include:

- prior working relationships between individuals from HEIs and local authorities (although where these did not exist excellent partnerships have still been built)
- a good structure to the programme with clarity of roles and focus
- regular and open communication and dialogue

- views of the local authority consultants being sought, valued and acted upon at all stages
- quick and positive responses and actions in response to feedback
- strong leadership of the programme from both HEI and local authority team members.

A number of HEIs have worked within a consortium with other HEIs - for example the Winchester consortium has included four HEIs. **This consortium approach to programme development and delivery appears to have been very effective in terms of pooling expertise and resources.** It has resulted in a greater volume of ideas and examples/exercises that have been proven to work being incorporated into the materials and a 'much richer' outcome. As two HEI consultees have commented:

We get on well as a consortium and we capitalise on each other's expertise and ideas. We share experience and resources and the workload.

We have pulled ideas from colleagues across all HEIs so the outcome is much richer...it is a unique package...the large consortium we work with has been invigorating and enriching and exciting.

3.5 What have been the challenges?

The MaST Programme has been delivered within a fast changing policy context. Since its inception in January 2010, it has experienced **changes in relation to both funding and staffing.** This has included reductions in funding to pay for supply time to support MaSTs to work collaboratively with their colleagues in schools and to allow MaSTs time out of the classroom to attend meetings with programme deliverers. In addition, in many local authorities, there have been redundancies of mathematics consultants, or changes in their role to take on a more generalist function. In most cases, these challenges have been effectively overcome but, in some cases, they have impacted on the effectiveness of the programme as explored below.

In the vast majority of cases the partnerships between the HEIs and local authorities have worked extremely well. Some respondents identified logistical, or 'teething' problems associated with launching the MaST Programme, and embedding its content and procedures but, in most cases, these challenges were successfully addressed through 'diplomacy and dialogue' and hard work. However, a small number of local consultants reported **ongoing challenges associated with partnership working** with their link HEI. There were isolated comments regarding the lack of recognition of, and capitalising on, the level of expertise that the local authority consultants brought to the programme. In addition, comments were made

regarding the need for improvements in communication and contact, for example when there had been staffing changes at the HEI, and in the quality of materials. A small number of HEI consultees said there had been communication issues with some of the local authorities they were working with and that, in the early stages of the programme prior to redundancies, not all of the local authorities had put in place adequate staffing to support the programme.

The redundancies of mathematics consultants, or changes in their role to take on a more generalist function, which took place during 2011 meant that, in a number of local authority areas, HEIs had to rethink their staffing arrangements:

For Cohort 1 and 2, the greatest challenges are where LA support has been either subject to change or there is no further LA support. So where the model has had to work around that, that has been the biggest challenge.

(HEI consultee)

As discussed in section 3.2, in most cases, successful solutions have been found but, **in some local authority areas, MaSTs have experienced disruption as a result of changes in their local consultant. Others have been brought together in larger groupings across local authorities and have lost the local support and expertise that they valued.** Where local authority staff have taken on a more generalist role, they have been less 'steeped' in mathematics and this has sometimes impacted on the level and depth of support they have been able to provide to MaSTs. A move of local authorities towards full cost recovery has also impacted on the time that local authority consultants have been able to give to the programme (although there are also examples of local authorities subsidising their MaSTs through paying for supply cover or the fees for Cohort 3 and 4 MaSTs).

Another challenge, which applies to a small number of schools, has been **the lack of active engagement of senior leaders in the programme.** This has, in some cases, limited the amount of work MaSTs have been able to undertake at a whole school level. The fact that MaST has become a low priority for government has meant that its profile locally has been affected and, where schools have other pressing priorities identified by Ofsted or being pushed by government, such as phonics, MaST has suffered. In addition a change of headteacher or a term without a headteacher has sometimes impacted on senior leader engagement in the programme. As two consultants commented:

Some [MaSTs] have clearly been better supported than others – more proactively encouraged and supported by their head. Some have been 'left to get on with it'. Much depends on the level at which senior

leaders are keen to use the benefit of MaST in the whole school development plan. Most headteachers have given due strategic thought to how they can maximise the impact of MaST in their schools.

(Independent consultant)

In some schools, typically where the MAST is on the senior leadership team, the role has been high profile and significant. In other schools, the MaST has been far less prominent. The backing or otherwise of the headteacher and senior leadership team has also made a big impact in terms of the impact on the school.

(Local authority consultant)

In the vast majority of cases, though, headteachers have been extremely supportive of MaST as shown by their response to the evaluation. In others, HEIs have increased their focus on communicating with headteachers and meeting with them early to agree an action plan for their MaST to work across the whole school in their second year. In many cases, MaSTs have still achieved what they set out to, sometimes without much senior leader support, as these HEI consultees report:

It's difficult to lead change in very turbulent times but this [the very high quality work of a MaST] is an example of where leading change actually empowered practitioners through those turbulent times

(HEI consultee)

The majority of heads have been fully behind it [MaST] and supported their teachers because they have seen the value of it

(HEI consultee)

The withdrawal of funding for supply cover in 2011 for the school visit has meant that challenges have sometimes been faced in securing meetings with headteachers. However, as mentioned above, in some cases, local authorities have provided schools with additional financial support, for example to pay for MaST supply cover for the school visit, out of their own budgets.

Pitching the local network meetings effectively and meeting all teachers' needs has been another key challenge for local authorities. This can be difficult with different levels of mathematics ability and teachers working in different Key Stages. For example, one local authority consultant commented:

It is very hard sometimes in local meetings to gauge the right level and meet everyone's needs. Some have very insecure subject knowledge and others are very sound. So there is a need to differentiate. There are also teachers working in the early years up to the top of KS2. There are some with a degree in mathematics and others a grade C GCSE so it is difficult to pitch.

The **demanding nature of a Masters level course and the time available to complete it on top of a full-time job has been a key issue for MaSTs**. Both HEI and local authority consultees have reported that some teachers had quite an adjustment to make to the Masters-level study and writing. After their experience of delivering the first year of Cohort 1, HEIs tended to increase the support given to MaSTs for their Masters level study. Time has also been an issue for MaSTs in terms of working with colleagues:

A key challenge is the time. They always want to do more and haven't got time in schools, Some get released more than others, some get released infrequently and I think there is a feeling of frustration that you feel that you have got the knowledge to do lots but there is the limitation of the time to do it.

(HEI consultee)

However, the majority of MaSTs, as reported by local authority and HEI respondents, have managed the programme well. As one HEI consultee commented:

There's a lot to achieve. It's very challenging but the teachers are getting a lot out of it. It's a lot of work but the feedback from Cohort 1 is very positive.

In addition, HEI interviewees have reported that few drop-outs from the course have related directly to workload; the majority have been due to changes in personal circumstances, such as maternity leave, family breakdown, looking after an ill or elderly relative or promotion.

4. MaSTs' experiences of the programme

Key findings

Views on components of the MaST Programme

- **The vast majority of MaSTs were very satisfied with the MaST Programme which has exceeded their expectations.** They had particularly appreciated the long-term nature of the programme and its focus on mathematics teaching and learning.
- **The three programme components that MaSTs found the most useful were attending the local half-day network meetings, collaborative working with colleagues at their schools and attending HEI sessions,** with the vast majority finding these components 'very useful' or 'useful'.
- In the second year of the programme, **some Cohort 2 MaSTs had experienced changes to local network meetings as a result of local authority redundancies.** This resulted, in a small number of cases, in this element no longer running or being less effective. However, in most cases continuity and high quality delivery was maintained.
- In general, **MaSTs felt well supported by their school** to meet the demands of the programme.
- MaSTs suggested changes to the programme **tended to relate to changes to the assignment writing,** for example more support and improved timing.

Time commitment and support

- Almost three-quarters of the MaSTs surveyed had been allocated time by their school to work collaboratively with their colleagues. About half of these reported they had been allocated about half a day or a day a term.
- Almost two thirds of the MaSTs surveyed felt that the time that they had been allocated was insufficient. A third of MaSTs said they would have liked two days a term to work collaboratively with colleagues.

Factors for success

- **Key factors that have led to MaSTs' success on the programme include: senior leadership support, seniority of MaST or MaST**

having a mathematics role in school, MaSTs' confidence in undertaking CPD with staff, having MaST activities in the School Development Plan and staff being open to new ideas/approaches.

This chapter explores the data from surveys of Cohort 2 MaSTs and headteachers. These two groups were surveyed three times during the evaluation – at baseline, midpoint and endpoint. In order to provide the most complete picture of the impact of the mathematics specialist role, the findings from the baseline and endpoint surveys form the central source of survey data presented here. An endpoint survey of Cohort 1 MaSTs was also undertaken and the findings from this were broadly similar across all questions to those for the Cohort 2 MaSTs endpoint survey. These findings are documented in an earlier report and, due to their similarity to Cohort 2 findings, are not explored separately here.

Also included here are the qualitative findings from case-study visits undertaken with ten Cohort 1 schools and fourteen different Cohort 2 schools. Cohort 1 schools were visited once while eight of the Cohort 2 schools were visited twice, at baseline and endpoint. Three of the Cohort 2 schools had to be substituted during the endpoint visits due to their MaSTs being on maternity leave at the time of the visit. Visits included consultations with MaSTs, teacher colleagues, headteachers and pupils and, where possible, local authority consultants.

This chapter explores:

- MaSTs' engagement in the various programme components
- views on the effectiveness of the components of the MaST Programme
- factors for success and barriers and challenges.

4.1 Engagement in the MaST Programme

This section explores MaSTs' engagement in the different components of the MaST Programme and their views on the time commitment of the programme and the support they have received to undertake it.

4.1.1 Engagement in the different components of the MaST Programme

In the surveys, MaSTs were asked about their involvement in the different components of the MaST Programme, specifically: HEI sessions, local authority half-day network meetings and visits by a local authority consultant/HEI representative.

Attendance at HEI sessions

Large numbers of MaSTs had attended HEI-delivered sessions in their various formats (see Table B.14 in Appendix B):

- 280 MaSTs (86%) had attended full day sessions
- 246 MaSTs (76%) had attended residential week-ends
- 169 MaSTs (52%) had attended half-day sessions
- 154 MaSTs (48%) had attended twilight sessions.

MaSTs were also asked how many of each type of session they had attended since the start of the programme, and the highest average number of sessions was for half-day sessions (13), then full day sessions (11), twilight sessions (7) and finally residential sessions (5).

In addition, 46 MaSTs mentioned other sessions/support that they had received from the HEI (see Table B.15 in Appendix B). This included online tutorials and conferences.

Attendance at local authority half-day network meetings

Ninety-five per cent of MaSTs confirmed that they had attended local authority half-day network meetings (three per cent responded that they had not attended any sessions and two per cent did not provide a response to this question).

The most common number of half-day network sessions attended was 10-12 with almost two-thirds of the MaSTs (63 per cent) having attended this number of sessions. About one in ten MaSTs reported attending 4-6 sessions (10 per cent) or more than 13 sessions (11 per cent). Only small proportions had attended 7-9 sessions (eight per cent) or fewer than four (three per cent). (See Table B.16 in Appendix B.)

Visits by a local authority consultant/HEI representative

Eight-four per cent of MaSTs responded that they had been visited by a local authority consultant. Almost half had been visited twice (48 per cent) while almost a third had been visited once (32 per cent). A small proportion (four per cent) had been visited three times or more. Fourteen per cent of MaSTs had not been visited by a local authority consultant. The case-study data suggests that some Cohort 2 MaSTs did not receive a school visit in the second year of the programme due to redundancies in their local authority.

In contrast, only eight per cent of MaSTs reported being visited by a HEI representative and all of them only once or twice. In the vast majority of cases, MaSTs were visited just by the local authority consultant or a HEI representative but a small number of MaSTs (two per cent) had received joint visits (See Table B.17 in Appendix B). It should be noted that HEI staff were not required to visit schools, and no direct funding was provided for this purpose.

4.1.2 Time commitment of the MaST Programme and support provided

MaSTs were asked about the time commitment of the various elements of the programme and whether it was 'too much', 'about right' or 'too little'. **The vast majority of MaSTs felt that the time commitment in terms of attending the local half-day network meetings and attending HEI sessions was 'about right'** (88 per cent and 86 per cent respectively). However, around a fifth of MaSTs felt that **the time allocated to the local authority consultant or HEI representative visiting the schools was 'too little'** (23 per cent and 19 per cent respectively).

There were mixed views regarding the time commitment for the self-supported study and assignments; over half of the MaSTs surveyed (58 per cent) felt that the time commitment for this element was 'about right' whilst two-fifths (39 per cent) felt that it was 'too much'. In some cases, schools have paid for cover out of their own budgets to support their MaSTs' academic study.

There were the same mixed views in relation to collaborative working with colleagues; around half of the MaSTs felt that the time was 'about right' (54 per cent) but about a third reported it was 'too little' (39 per cent). (See Table B.26 in Appendix B.)

When asked in an open question why they had answered 'too much' or 'too little' to any of the options presented above, 138 MaSTs provided at least one response (see Table B.27a in Appendix B). **A single main reason emerged relating to MaSTs**

finding it difficult to dedicate time to self-study e.g. with existing work commitments, while maintaining work-life balance (49 per cent).

Linked to the question above, MaSTs were asked about the **levels of support that they had received within school** to undertake collaborative working with colleagues. **Almost three-quarters of MaSTs (73 per cent) reported that they had been allocated time in their school to work collaboratively with colleagues. However, almost one in three (27 per cent) reported that they had not been allocated any time for this element of the programme.** (See Table B.22 in Appendix B).

MaSTs reported that the most common amount of time allocated was ‘about half a day’ a term (30 per cent), followed ‘about one day’ (19 per cent) a term. Almost a quarter (23 per cent) reported being allocated 2 days or more. A notable minority (28 per cent) did not answer the question. (See Table B.23 in Appendix B.)

A high proportion of MaSTs felt that they had not been allocated enough time to work with colleagues. When asked a question in this regard, almost two-thirds of the MaSTs (63 per cent) responded that the time that they had been allocated was not sufficient (see Table B.24 in Appendix 4). A third (33 per cent) were happy with the time that they had been allocated. Those MaSTs who felt that the time that they had been allocated was insufficient were asked how much time they felt they needed to work with colleagues (see Table B.25 in Appendix B). About a third of MaSTs (35 per cent) said they needed two days each term to satisfactorily deliver this part of the programme. This was followed by one day (21 per cent), four days (14 per cent), and three days (11 per cent), with smaller percentages of MaSTs responding that they would need five, six or seven days (14 per cent overall).

The vast majority of headteachers (95 per cent) reported that they had allocated time for their MaSTs to work collaboratively with colleagues, with only four per cent saying they had not allocated any time (see Table A.4 in Appendix A). These figures are different from the MaSTs’ own reports although the headteachers and MaSTs surveyed were not all from the same schools. The most common amount of time reported to be allocated by headteachers was one day (33 per cent) followed by two days (21 per cent). A notable minority (11 per cent) reported allocating five or more days (see Table A.5 in Appendix A). These numbers are again higher than those reported by MaSTs.

Headteachers were asked to what extent colleagues in school had invested time to support the MaST fulfil the MaST Programme requirements and embed activities in school. **Headteachers reported that ‘other staff’ (i.e. teaching colleagues) had spent the most time with almost three-quarters answering ‘to a great extent’ or ‘to some extent’ (73 per cent). The senior leadership team and the**

headteachers themselves were reported to have dedicated a similar amount of time (67 per cent and 64 per cent respectively reporting ‘to a great extent’ or ‘to some extent’). (see Table A.8 in Appendix A).

Headteachers were asked if there had been any challenges in supporting a member of staff to participate in the MaST Programme and about seven out of ten reported that there were no challenges (71 per cent). However, about a quarter of headteachers felt there were challenges in supporting staff in participating in the programme (26 per cent). When asked in an open-ended question to explain the reason for the challenge, 105 headteachers provided at least one response (see Table A.7 in Appendix A). **Again the most commonly reported challenges to supporting staff to engage with the programme were time issues (58 per cent) and financial cost (19 per cent).** These were followed by school-specific issues not related to the programme.

Data from the case studies confirmed that insufficient time had been a key issue for MaSTs, particularly in relation to self study and collaborative working in school: ‘Time is the biggest issue’ (Cohort 2 MaST). In addition, it confirmed that a key challenge for schools had been cost of supply cover. In particular, once funding to pay for supply cover for teachers to work with colleagues was withdrawn for Cohort 2 and Cohort 1 in the second year, schools struggled to find their own funds to pay for supply cover. In many cases, MaSTs had spent much of their own personal and PPA time preparing for and completing collaborative activities.

4.2 Views on components of the MaST Programme

This section explores MaSTs’ views on the effectiveness of the various components of the MaST Programme. It also outlines their suggestions for changes to the programme in terms of its structure, content and delivery. This section draws on survey questions where MaSTs were asked to answer using a 1-to-5 response scale (where 1 was ‘very useful’ and 5 was ‘not at all useful’). In this situation, the respondent was asked to decide whether they leaned more towards the ‘very useful’ (e.g. 1 and 2) or ‘not at all useful’ (e.g. 4 and 5) end of the scale for each item or if they were somewhere in between (3 – to some extent).

4.2.1 Views on programme overall

MaSTs were asked to rate on a 1-to-5 response scale (where 1 was ‘very useful’ and 5 was ‘not at all useful’), how useful they had found the different components of the programme in terms of developing their teaching of mathematics.

The **three programme components that MaSTs found the most useful were attending the local half-day network meetings, collaborative working with**

colleagues at their schools, and attending HEI sessions, with 90 per cent, 89 per cent and 85 per cent respectively of MaSTs responding with a 1 ('very useful') or 2 response.

Table 4.1 Teachers' views on usefulness of the MaST Programme components

On a scale of 1 to 5, how useful have you found the following components of the programme in terms of developing your teaching of mathematics?									
	Very useful		Fairly useful		Not at all useful	Don't know	Have not done this	No response	Total
	1	2	3	4	5				
	%	%	%	%	%	%	%	%	%
Attending HEI sessions	58	27	9	3	1	0	1	1	100
Attending local half-day network meetings	66	24	6	1	0	0	2	1	100
Being visited at school by a local authority consultant/ network coordinator	19	30	21	10	3	2	14	0	100
Collaborative working with colleagues at your school	51	37	9	1	1	0	0	0	100
Self supported study and assignments	24	45	21	8	2	0	0	1	100
Being visited at school by a HEI representative	4	5	1	1	1	4	82	2	100
N = 324									

A series of single response questions.

Due to rounding percentages may not sum to 100. Source: NFER postal survey of MaSTs, 2012

MaSTs were then asked which component of the programme had led to the greatest impact on the way in which they taught mathematics. The single highest response was attending HEI sessions (37 per cent), followed by attending the local half-day network sessions (31 per cent).

When asked, almost half of the MaSTs (48 per cent) would not suggest any changes to the programme's structure, content or delivery (see Table B.20 in Appendix B). Of

the 47 per cent of MaSTs who did suggest changes, a wide range of suggestions were given with only small proportions of MaSTs giving the same suggestion. In some cases, suggestions made by different teachers were conflicting (see Table B.21 in Appendix B).

The three most commonly reported suggestions all related to assignment writing, and are shown below:

- general comments about making changes to the assignment writing (mentioned by 12 per cent of MaSTs)
- a specific comment about the need for more support with assignment writing (ten per cent)
- a specific comment about assignments being badly timed (e.g. they clashed with busy times in school).

Findings from the case studies mirror the survey data and suggest that the **vast majority of MaSTs had been very satisfied with the MaST Programme which had exceeded their expectations**. In particular, the HEI sessions and local network meetings, with their mix of theory and practice, had been highly valued and were seen to complement each other:

You have self-study tasks, which are things that you kind of do on your own, and they've been things like an audit of your skills, and the resources that you use, and different aspects of teaching ... those [things] have led into personal learning logs, which you've sent on to university, and then the personal learning logs lead into the assignment ... and the readings that they've given you are relevant to all those things ... so yeah, it has lots of little compartments, but they do seem to connect.

(Cohort 2 MaST)

Teachers and headteachers had particularly appreciated the **long-term nature of programme** and meeting with the same group of people over time:

It's a more solid form of CPD than just a one-off day. I think that's been a real strength of the programme.

(Cohort 2 Headteacher)

Also highly valued had been the primary **focus on mathematics teaching and learning** as these MaSTs commented:

It's really fantastic to have this focus on mathematics and the school knows how valuable it is, to fight its [mathematics'] corner. It's a really good idea having a specialist in school.

(Cohort 2 MaST)

Below are just a few of the comments that school consultees have made to sum up their experience of the programme and how valuable it has been for MaSTs, colleagues and schools:

...It has exceeded my expectations. I thought it would be more about developing my mathematical professional knowledge and understanding, which it has done, but we've also focused a lot on the pedagogy and actually teaching mathematics, effective strategies to use with children.

(Cohort 1 MaST)

It has been the best CPD and makes all others fade into insignificance. It has had a huge impact on me, the school and individual teachers whereas other colleagues who have done Masters have had no impact on me.

(Cohort 1 MaST)

It's been massively valuable, everyone has taken it on board – even the people who haven't been involved directly...it's been really worthwhile, I've enjoyed being part of it.

(Cohort 1 Teaching colleague)

I think for the MaST teacher it's been an outstanding experience...the course is of a very high level...she's learnt a huge amount.

(Cohort 2 Headteacher)

4.2.2 Perceptions of the HEI sessions

Although there were some variations in approaches to delivery and content, with some HEI sessions taking a more lecture style format and others being more interactive, overall, **case-study MaSTs felt that the HEI sessions had been of a consistent high quality throughout the two years and described them as 'hand-on', 'thought provoking', 'buzzy' and 'fantastic'**. Headteachers, too, had noted their impact on their MaSTs and the importance of the HEI lead within the

programme in the context of local authority cuts: '[there's a] real buzz from it and it's carried on for the two years' (Cohort 2 Headteacher).

MaSTs reported that sessions had been led by specialists in mathematics subject knowledge and pedagogy and, in many cases, had included inspiring keynote speakers (often described as 'engaging' and 'inspirational'), who had successfully pitched sessions appropriately for practising teachers:

The course has fulfilled my expectations and I have been overly pleasantly surprised that the lecturers – who are not in school every day – have delivered seminars, that the things they have been talking about and demonstrating have been really appropriate...It's getting the opportunity to think about the bigger things that you don't have the time to do on a daily basis.

(Cohort 2 MaST)

MaSTs reported that the HEI sessions had the right balance of theory and practice, including allowing teachers the opportunity to try out high quality activities that they could take back to the classroom. One Cohort 1 MaST's description of them echoed the comments of many others: 'very practical, hands-on and focused on the classroom'. In addition, the focus of some HEIs' sessions on 'big ideas' had given MaSTs the confidence to approach whole topics in mathematics (rather than, for example, an individual lesson).

MaSTs portrayed the HEI staff delivering sessions as helpful and knowledgeable and felt that they had come away from sessions with lots of new ideas to draw on in their day-to-day work. Although tiring, attendance at the HEI sessions was seen as very worthwhile:

You wake up on a Saturday morning when you've done a whole week of teaching and think 'Oh God', but actually, it's such a buzzy day and it's so well planned, so well implemented, and you feel you're really in the hands of experts, it's fabulous... then impacts on what you do in school. You're excited about what you've learned, and it manifests itself on the children.

(Cohort 2 MaST)

Headteachers also commented on MaSTs coming back from 'fantastic' sessions with new ideas and being 'fired up'. Both MaSTs and their headteachers had valued the opportunity teachers were provided with to network with other teachers across local authority areas. In particular, the residential element

had allowed MaSTs to immerse themselves in the programme and to make strong friendships with other teachers.

As the programme progressed, MaSTs appreciated the focus on lesson study which had been effective in supporting MaSTs to change the practice of their colleagues:

Having quality time to discuss and not on a critical level, it was brilliant. We often try things in school and think 'that's not for us'. This [lesson study] is one thing that we really want to keep going and hence we've budgeted for it next year. I think that shows that it's valued.

(Cohort 2 MaST)

There were a small number of criticisms early in the programme covering both organisation and content. One MaST commented on there being time 'sitting around' during HEI days and another commented on insufficient notice in relation to tasks that MaSTs were required to complete with colleagues in other Key Stages. One MaST commented on the focus being on Key Stage 2 rather than Key Stage 1 and in one HEI area a MaST commented that the sessions led by HEI staff were less inspiring than those of outside speakers. However, these issues were generally resolved as part of the HEIs' ongoing evaluation process.

In the second year, one MaST was not offered any HEI sessions and, as a result found the self study element much more difficult without face-to-face support and guidance. Another felt the loss of the residential element and suggested that it was kept in both years as it helped to 'immerse teachers in the programme, properly digest information and develop networks' (Cohort 2 MaST).

4.2.3 Perceptions of local authority network meetings

Case-study MaSTs were similarly complimentary about the local authority network meetings with many describing them as the best element of the programme due to them allowing MaSTs to discuss practice, share ideas and issues and ask questions in small, local, close-knit groups in which they all learnt from each other:

The small cluster meetings, our local meetings, they were brilliant, absolutely wonderful. That's the area that I feel really helped develop me – meeting up with [name of mathematics lead in local authority]... That was the most valuable part for me. We sat as a small group and discussed any issues in class, resources, idea for teaching – I really learned a lot...it gave me confidence.

(Cohort 2 MaST)

It was useful to see what other people were doing...That's something in teaching you don't often get – the chance to talk about a lesson and reflect.

(Cohort 1 MaST)

Headteachers were also positive about the sessions and how their teachers benefitted with one headteacher describing them as 'invigorating'.

Several MaSTs reported creating their own, smaller networks of teachers as a result of relationships developed through the programme. For example, one MaST teaching in a small school had met regularly with fellow MaSTs in similar schools to discuss their assignments and developing strategies for teaching mathematics:

The group...bonded really well and we've got our own little network going...so we've still got that contact with somebody else who is leading mathematics in a school.

(Cohort 1 MaST)

However, MaSTs had also valued meeting other teachers from diverse settings which they felt was unique as school improvement programmes tended to bring together schools in particular categories. Headteachers too felt that this was positive:

I would say the local authority meetings [have been most valuable] because it's given me the opportunity to network with people who are in different circumstances and different settings.

(Cohort 2 MaST)

Having skilled, enthusiastic, on the ball subject leaders ... [with] experience outside the walls of their own school, via the programme, can only put schools in a strong position to deal with whatever's coming.

(Cohort 2 Headteacher)

By the end of the course, a number of Cohort 1 and 2 MaSTs were observing each other's lessons and some were communicating online, for example via Facebook, and buddying each other, for example Cohort 1 MaSTs buddying Cohort 2 teachers.

MaSTs reported that local network meetings had generally involved a combination of mathematics activities and discussion, with the latter covering the activities undertaken as a group and individually back in school:

We talk about things we've developed in school, and we all have to take an issue that we want to talk about and then we get coached through how to work our way through it, which is actually very useful.

(Cohort 2 MaST)

In one area, action learning sets had been delivered which, over time and once they got used to this approach, MaSTs reported as working very effectively.

Local authority consultees interviewed during case-study visits reported the high quality of discussion that took place in the local meetings. As one local authority consultant commented: 'the level of debate that takes place at those network [meetings] is like nothing I've ever experienced before. The depth ... is second to none'.

Case-study MaSTs were very positive about the abilities of the local authority personnel running the sessions, for example describing them as 'charismatic' and 'engaging'. They also noted their familiarity with primary education and their ability to support them through the challenges of balancing academic and teaching commitments: 'They see exactly where we are coming from, and the difficulties we have'. They also commented on the high quality of their one-to-one support and local consultants' ability to facilitate lively discussion and debate and to structure the sessions well ensuring they complemented the HEI sessions:

The network meetings are always useful, there is no 'fluff' and the way they are broken up is coordinated to complement the HEI session.

(Cohort 1 MaST)

As mentioned earlier in the report (chapter 3), due to structural changes in local authorities, some MaSTs experienced changes in personnel running local network meetings in year 2 of the programme. One case-study MaST commented that the delivery was not as effective after this and two others commented that local meetings had not run in year 2 of the programme which was a loss. However, others commented that their local consultant remained in post, or was employed directly by the HEI, which meant that continuity, quality and a high level of support had been maintained.

4.2.4 Views on independent study and tutor support

The MaSTs interviewed as part of the school case studies described a number of learning activities that they were expected to carry out independently, including:

- auditing and developing their own mathematical skills
- maintaining professional journals or ‘learning logs’ (‘where we’ve identified critical incidents [and] light-bulb situations’), and
- researching and writing academic assignments.

The information the case-study MaSTs provided on their educational and professional backgrounds suggested that there had been considerable variation in how onerous the first of these activities had proved to be, with **the development of their own mathematical skills and knowledge being a fairly substantial undertaking for a few people**. One Cohort 2 MaST explained: ‘It’s like learning a different language, especially if you don’t have a mathematics background ... in some ways it makes me feel like the children!’

Between HEI sessions and local network meetings MaSTs were tasked with undertaking a range of activities within their own class and with other teachers in school, within and outside their own Key Stage. MaSTs generally found these tasks useful and, over time, they linked more and more to what they were doing in their own classroom:

It’s [year 2] been a bit more about work with colleagues and ‘try this in class, try this’ which is beneficial for us...it actually feels like it fits in with your role.

(Cohort 2 MaST)

Teachers were asked to use their learning log to record activities and reflections between sessions and to share these with their HEI tutors and local consultants. MaSTs varied in their enthusiasm for keeping these learning logs with a small number admitting to being less than conscientious about their completion and another saying there was a lack of clarity in relation to how they should be used. However, most MaSTs welcomed the encouragement to reflect on their classroom practice and saw the learning log as a critical plank of the programme:

This programme has got time for self-reflection, and everything that you’re engaged with and encountering, and that they’re talking to you about, you are having to reflect on ... we have to keep a ‘learning log’

and ... it forces you to become more self-reflective – and that's been brilliant.

(Cohort 2 MaST)

Some MaSTs found undertaking Masters level study challenging and time intensive. In particular, MaSTs who had not undertaken academic work for several years found adjusting to high level academic study and assignments difficult. Local authority consultants reported that, in some cases, this related to insufficient lead in time to recruit Cohort 1 and 2 MaSTs which meant that they did not have time to properly 'vet' all of the teachers applying and ensure that they were aware of the level and workload of the programme. A number of MaSTs reported that they found their first assignment particularly 'daunting' and felt that they required more support than was provided. In response to this feedback, HEIs built in more support for future assignments. One MaST, who made the difficult decision to withdraw from the programme due to the time commitment, suggested that more practical ways of assessing teachers' progress in programmes like MaST could be introduced such as observation and interview.

However, most MaSTs were enthused by the chance to research and reflect on big ideas and adapted well to the demands of the academic reading and assignments and established their own routine. One MaST commented on the need for teachers taking part in the programme to be self-motivated and well organised to cope with the demands of the programme on top of a full-time job. Another commented: 'I think the more you get used to it, the more it becomes a natural task' (Cohort 2 MaST).

In general, MaSTs found the quality of tutoring to be good, with strong mechanisms for support and feedback built into the provision. Although one of the Cohort 2 case-study MaSTs had withdrawn from the programme, she spoke highly of her tutor's support: 'The staff at [HEI name] were wonderful, anything that was needed they were only a phone call away. It was great at [name of HEI]. I loved going, there were very supportive staff and tutors, it was more my issue than their issue'. However, two MaSTs reported variation in the support provided by tutors with some MaSTs receiving high level ongoing support and others receiving short and less thorough responses to emails.

4.2.5 Perceptions of senior leadership support in school

In general, case-study MaSTs reported that they had been well supported by their schools to meet the demands of the programme, although the nature and extent of this support varied. The **encouragement of the school's senior leadership team** was considered to be an essential component of successful engagement in the

programme, and most MaSTs felt that they had received the support they needed in this respect. A number of headteachers were well aware of the demands of the programme and the support required by their MaST:

I am aware though of how exhausting it is for the teacher juggling it with the day job. It is a very heavy workload and they [MaSTs] need a lot of support.

(Cohort 2 Headteacher)

MaSTs reported, variously, that they had received support from their senior leadership team including:

- **non-contact time:** this included time for independent study as part of the MaST Programme, as well as planning time to address whole-school mathematics development priorities
- an **allocated budget:** this was generally provided to allow MaSTs to purchase mathematics resources and equipment. Budget for staffing (e.g. for supply cover to enable teachers to work collaboratively together) was generally resourced separately and was less commonly provided
- **time and resources to share knowledge and work collaboratively with colleagues:** most commonly, this included training at INSET days and sharing information at staff meetings. Time to work on extended programmes of work with colleagues was less common due to issues with lesson cover, and MaSTs reported that they would welcome greater opportunities to undertake this type of work.

The nature of the support offered to MaSTs varied according to their role in the school. Classroom teachers, for example, tended to require more special provision for non-contact time to meet the school-wide demands of the course than non-teaching deputy headteachers, who found they had more flexibility in their school timetable. Although the level of support offered by the headteacher varied, participants reported that it was vital that headteachers gave MaSTs an opportunity to input into wider school change, such as the School Development or Improvement Plan or management decisions related to mathematics, for the programme to be successful. One member of local authority staff reported that MaSTs working in schools with the support of the headteacher had a greater impact on pupils than those who did not have a supportive senior leadership team - either because they prioritised other matters or were unaware of the potential benefits of the MaST Programme:

Headteacher support is vital because there are conflicting priorities in school and if the headteacher is not championing the programme it will be difficult to sell it to other teachers because it is a lot of work.

(Cohort 2 MaST)

The impact that a MaST may have in a school is very much determined by the leadership.

(Local authority consultant)

4.3 Factors for success and barriers and challenges

4.3.1 Factors for success

A range of facilitating factors have supported teachers to successfully complete the MaST Programme and, in particular, to undertake their whole school improvement role working with staff from across their school. These factors are explored below.

As mentioned previously, **support from the senior leadership team** has been crucial for the success of the MaST's collaborative work in school. Another key factor for success in relation to MaSTs' whole school improvement role has been the **seniority of the MaST**, for example being part of the senior leadership team or already being the school's mathematics lead or coordinator. Already having a senior and or/mathematics-related role has meant that headteachers have been more likely to support their MaST with time and financially (e.g. for supply cover) and in setting aside time during meetings and within the INSET plan to incorporate MaST activities. In addition, staff in senior roles have had more flexibility in how they use their time and found it easier to encourage other staff to take on MaST-related activities due to the respect they already have in school. As one Cohort 2 headteacher whose MaST was on the senior leadership team commented:

I know that [MaST's name] will deliver so it's not taking a gamble to support it financially...Her credibility is very high within the school and there is respect for her own teaching. They do have to have good to outstanding teaching themselves to have the credibility to drive some of these things that we are asking them to do...

(Cohort 2 Headteacher)

This does not mean that MaSTs who were not in these positions have not achieved changes across their school. Many have still received support and, in many cases,

those who were not initially the mathematics lead have now become that as a result of MaST. However, where MaSTs have not been in senior positions and have lacked strong senior leadership support, they have tended to primarily make changes within their classroom or with small numbers of colleagues rather than across the whole school.

The seniority of the MaST's role in school has been key to success but, linked to this, has been the **MaST's confidence in undertaking CPD with staff across the school**. In many cases, this has been synonymous with seniority in school but not always.

Having **MaST activities in the Schools Development/Improvement Plan** or as part of a school action plan has also been a key factor leading to the success of MaSTs' work across the school. Alongside this has been **teachers in the school being open to new ideas/approaches**. As one Cohort 2 MaST reported:

I am very lucky as everyone in the school likes and values talking about what they do with the children and they love INSET. They really engage in the time that they have together and enjoy working together on MaST as they feel it will benefit the children ultimately.

Where MaSTs have not found all staff in their school to be on board in relation to engaging with MaST activities, a successful strategy that some MaSTs have used has been to **convince key staff members of its value and benefits** and then it can develop from there, as this Cohort 2 headteacher and colleague report:

She's sought out key people to support her and you need that...Unless you've got that, it's extremely difficult to get things moving forward.

We all thought of it as quite challenging in the beginning, because it's new...once you look at the benefits to the children and how much they get out of it, then we have to embrace the new strategies...

Also a key factor for success has been the **time management and organisational skills** of the MaST.

4.3.2 Barriers and challenges

Some MaSTs have experienced barriers to their successful completion of all aspects of the MaST Programme, particularly the whole school improvement component. In many case, these barriers are the mirror images of the factors for success.

As well as the key issue of time, a lack of senior leader support to work with colleagues across the school has been a challenge that some

MaSTs have faced which one MaST described as ‘not catching fire whilst the sparks are there’. Often this has occurred in schools where practice in mathematics has been perceived to be already effective or where the school has had other pressing priorities, such as literacy and supporting pupils with English as an Additional Language (one headteacher described trying to tackle all priorities as ‘spinning plates’). In addition, some headteachers have seen this as a task for the MaST to undertake once they are free from the demands of the programme as this consultant comments:

The programme would aim to have [name of MaST] spread the alterations in practice beyond her own immediate classroom and I think perhaps that sometimes the headteachers, including [name of MaST’s] headteacher, have felt that this may not necessarily be appropriate either at this point in time because the school has other priorities or that being kind to the MaST teacher and being supportive to the MaST teacher, they feel that might be overloading them a bit when that may not necessarily be the case...A lot of the headteachers think that it is appropriate that that should take place after they’ve finished the two-year programme.

(Independent mathematics consultant)

Where MaSTs have not been the mathematics coordinator or have not held a senior position in school, they have faced more difficulties in persuading colleagues to embed MaST activities in their lessons and several headteachers have commented on the need for the MaST to have a senior role:

My recommendation would be that it needs to be someone of a more senior level...when a member of the leadership team or a TLR says this is what’s going to happen, it tends to be what happens with all the staff...So try to make sure they are the mathematics subject leader or a more senior person in the school.

(Cohort 2 Headteacher)

MaSTs who were not the subject leader/coordinator for mathematics/ numeracy and have not have automatic access to the authority, channels or resources associated with this role have particularly struggled where senior leadership support has not been forthcoming.

A lack of teaching experience, or confidence in their mathematics ability, has been a barrier for some MaSTs in embedding MaST practices across the school. A reduction of local authority support for Cohort 2 teachers

in their second year of the programme has meant that they have not had someone external 'backing them up' and convincing the headteacher and staff to embrace MaST, as this Cohort 2 MaST explained: 'Without the LA support, there is nobody to back me up that what I'm saying is right'. One headteacher commented that the programme could usefully build in more support to help junior staff grow into the mathematics coordinator role and take on managerial and more strategic functions.

Linked to senior leader support for MaST, **some MaSTs have experienced a lack of staff buy-in** to the programme. Again, this has often occurred when the school already has good results in mathematics. One MaST reported colleagues being reluctant to engage in activities that did not explicitly identify a learning objective or fit within the model 3 part lesson valued by Ofsted and another commented that as staff were short of time some preferred to fall back on tested methods requiring less preparation time. A further MaST who was not the school's mathematics subject leader reported difficulties in implementing MaST activities when the subject leader in post had their own ideas and ways of working.

MaSTs have also reported working with colleagues who lack confidence in their mathematics teaching and, as a result, are reticent about trying out new approaches as this Cohort 2 MaST reports:

Maths is a subject that most of them will voluntarily say to me 'I don't feel comfortable with it' so to get those people to take a chance on what they're teaching in numeracy is a real challenge.

Some MaSTs have found that being reliant on the cooperation of other teachers has impacted on their ability to complete their assignments:

Some colleagues have been very supportive and keen to be involved whereas others have been more reluctant saying 'I haven't got time, I can't do this' so finding that you have to be reliant on other people has been extremely difficult.

(Cohort 2 MaST)

Going forward, MaST felt that, if the new summer 2012 consultation draft of primary mathematics curriculum was approved as it was, it would provide an additional challenge to embedding a more creative and investigative element into mathematics. They perceived it as 'a prescriptive curriculum focused on pupils knowing facts and figures and being able to do certain methods earlier than they are able to understand them'.

5. Impacts arising from the MaST Programme

Key findings

This chapter draws on questionnaires completed by teachers, headteachers and pupils in MaST schools and comparison schools and an analysis of data from the National Pupil Database (NPD).

- The research highlighted considerable personal impacts on teachers, relating both to their mathematics **subject-specific pedagogy and their subject knowledge**.
- In MaST schools, headteachers and MaSTs were in agreement that the programme had had a **positive impact on participating teachers' practice**.
- Further, confidence in their own effectiveness had **significantly increased since the baseline survey**, and had increased **more than that of comparison teachers**. This finding held true across the whole mathematics curriculum, but was particularly the case for 'using and applying mathematics'.
- Responses from teachers and headteachers showed that the programme had particularly impacted on teachers' subject knowledge **within the Key Stage that they currently taught, but that there were some wider gains within the Key Stage/s that they did not currently teach**.
- In the view of the MaSTs, the MaST Programme **had a positive impact on the attitudes of pupils in their school, in terms of their enjoyment of and confidence in mathematics**. This perception is **only partly supported by the pupil survey**.
- **Almost three-quarters of MaSTs reported that their pupils' attainment was better than expected over the previous year**, and this proportion had increased substantially since the baseline survey. The analysis of pupil results suggested **that this perception was not yet borne out by national assessment results**.
- There were indications **that MaSTs felt more confident, and engaged more frequently, in collaborative activities with colleagues as a result of the programme**.
- MaSTs reported strongly that the programme had had an impact on the **priority given to improving the quality of mathematics teaching and learning, and to improving attainment and standards in schools**.

This chapter explores the impacts arising from the MaST Programme. In particular, it explores the impact of the MaST Programme on:

- teachers' subject-specific pedagogy and subject knowledge
- collaborative approaches to improving mathematics
- pupils' attitudes and attainment
- standards of teaching and learning and impacts on whole school improvement.

The chapter draws primarily on data from the surveys of Cohort 2 MaSTs and comparison teachers, headteachers and pupils; as well as findings from the case studies of Cohort 1 and Cohort 2 MaSTs; local authority and HEI deliverer interviews; and data from the National Pupil Database (NPD). As described in section 4, an endpoint survey of Cohort 1 MaSTs was also undertaken and the findings from this were broadly similar across all questions to those for the Cohort 2 MaSTs endpoint survey. These findings are documented in an earlier report and, due to their similarity to Cohort 2 findings, are not explored separately here.

5.1 Teachers' perceptions of impacts on the effectiveness of their teaching practice

In order to gauge the perceived impact of the programme on MaSTs' teaching practice, MaSTs and their headteachers who responded to the survey were asked **to what extent the participating teacher's mathematics teaching practice had improved overall** as a result of their involvement in the MaST Programme. They were asked to rate their views on a five point scale, where 1 was 'to a great extent' and 5 was 'not at all'.

MaSTs were highly positive about the extent to which they had improved their teaching practice throughout the programme, with the vast majority (92 per cent) responding with a 1 or 2, and over half (52 per cent) providing a 1 response ('to a great extent'). None of the teachers reported that the MaST Programme had not had an impact on their teaching practice at all (see Table B.32 in Appendix B). These views were echoed by headteachers, the vast majority (83 per cent) of whom responded with a 1 or 2 and over one-third (34 per cent) provided a 1 response ('to a great extent') (see Table A.10 in Appendix A). This suggests that, overall, **both headteachers and MaSTs were in agreement that the programme had had a positive impact on participating teachers' practice.**

5.1.1 The nature of developments in mathematics teaching and learning

The research highlighted a number of developments in MaSTs' subject-specific pedagogy, arising from their participation in the programme. These are explored in the following sub-sections.

Findings from the teacher and headteacher surveys

To gain a detailed insight into the impacts on teaching practice, MaSTs were asked how effective they felt their mathematics practice was across a range of areas. Again, teachers were asked to rate their views on a five point scale where 1 was 'very effective' and 5 was 'not at all effective'. The findings are presented in Table 5.1 below.

Table 5.1 MaSTs' perceptions of the effectiveness of their teaching practice across a range of areas – endpoint survey

	Very effective		Fairly effective		Not at all effective	Don't know	No response	Total
	1	2	3	4	5			
	%	%	%	%	%	%	%	%
Setting high expectations for all pupils and knowing when these have been met	62	34	3	0	0	0	1	100
Using practical resources, such as models, materials and objects to illustrate ideas, structures and processes	61	35	3	0	0	0	1	100
Challenging more able pupils	61	35	3	0	0	0	1	100
Helping pupils to understand and use mathematical language and vocabulary	60	37	2	0	0	0	1	100
Using images to develop pupils' understanding of mathematical ideas and concepts	56	38	5	0	0	0	1	100
Teaching mathematics in an engaging way	54	41	4	0	0	0	1	100
Planning progression in the mathematics curriculum	51	44	4	0	0	0	1	100
Linking mathematical ideas to 'real world' situations	49	44	6	1	0	0	1	100
Understanding why pupils make mistakes and rectifying their misconceptions	48	47	4	0	0	0	1	100

Undertaking periodic assessments in mathematics and using assessment information to inform planning	41	47	10	1	0	0	1	100
Helping pupils to make connections between different topics within the curriculum	43	44	11	1	0	0	1	100
Scaffolding learning in ways that help pupils to carry out tasks systematically	48	45	6	0	0	0	1	100
Building Assessment for Learning into day-to-day mathematics teaching	39	51	10	0	0	0	1	100
Supporting pupils when undertaking lines of enquiry	39	52	7	0	0	0	1	100
Personalising the teaching and learning of mathematics	38	51	10	0	0	0	1	100
Using ICT to support the learning of mathematics	23	48	25	3	0	0	1	100
Working with pupils across the primary age range and EYFS	13	48	31	4	2	1	2	100
N = 324								

Source: NFER postal survey of MaSTs, 2012

Due to percentages being rounded to the nearest integer, they may not sum to 100

Table 5.1 shows that the **area where teachers were most positive was ‘setting high expectations for pupils’**, with over three-fifths (62 per cent) reporting their practice was ‘very effective’ in this respect. This was closely followed by ‘using practical resources to illustrate ideas, structures and processes’, and ‘challenging more able pupils’ (61 per cent of teachers reported being ‘very effective’ in both of these areas). **The area of practice where teachers felt least effective was ‘working with pupils across the primary age range and Early Years Foundation Stage (EYFS)’**, with just 13 per cent of teachers feeling ‘very effective’ in this area.

Additional analysis revealed that, when compared to the baseline, MaSTs reported improvements in all of these areas, suggesting that there had been **substantial gains in how MaSTs perceived the effectiveness of their mathematics teaching practice**. This analysis needs to be approached with some caution, as the teachers responding to the endpoint questionnaire were not all the same as those responding at baseline. However, a separate analysis based on those teachers who were the same for both surveys (around 100-200 in number, varying from question to question) confirms a general pattern of significant increase amongst the MaST group.

Furthermore, MaSTs appeared to have gained confidence at a much greater rate than their counterparts in the comparison schools. **The greatest gain was in ‘using practical resources, such as models, materials and objects to illustrate ideas, structures and processes’**. Further details can be found in Table 5.2.

Table 5.2 Extent to which teachers' views on their effectiveness in 'using practical resources' has changed between the baseline and endpoint surveys

	Cohort 2 – Baseline	Cohort 2 – Endpoint	Difference	Comparison – Baseline	Comparison – Endpoint	Difference
	%	%	%	%	%	%
1 Very effective	9	61	+52	25	38	+13
2	30	35	+5	45	46	+1
3 Fairly effective	44	3	-41	26	15	-11
4	15	0	-15	2	1	-1
5 Not at all effective	1	0	-1	0	0	0
Don't know	0	0	0	0	0	0
No response	0	1	+1	1	0	-1
Total %	100	100		100	100	
	N=415	N=324		N=203	N=240	

Source: NFER postal survey of MaSTs and comparison teachers, 2011-2012

Due to percentages being rounded to the nearest integer, they may not sum to 100

Table 5.2 shows an increase of 52 percentage points in MaSTs who reported feeling 'very effective' in using practical resources at the endpoint compared to the baseline. In the same period, the proportion of comparison teachers reporting that they were 'very effective' was only 13 percentage points higher.

Improvements were also reported across the other areas (see Tables F.28-F.44 in Appendix F). When collapsing the proportion of 1 ('very effective') and 2 responses, the biggest gains in perceived effectiveness were reported in the following four areas (in descending order of percentage point increase):

- supporting pupils when undertaking lines of enquiry (MaSTs +58 points, comparison teachers +13 points)
- using practical resources (MaSTs +57 points, comparison teachers +14 points)
- using images to develop pupils' understanding of mathematical ideas and concepts (MaSTs +57 points, comparison teachers +12 points)
- understanding why pupils make mistakes and rectifying their misconceptions (MaSTs +54 points, comparison teachers +8 points).

Findings from the case studies

Case-study participants echoed the views of MaSTs and headteachers who participated in the surveys, reporting that involvement in the MaST Programme had increased their **confidence and effectiveness in using a range of teaching methods**. This was considered to be a fundamental impact arising from the programme. Whilst closely linked with associated improvements in their subject knowledge, MaSTs had particularly benefited from the opportunity to explore, test out and apply new approaches to teaching mathematics.

Through their work in their own classrooms and their work with colleagues, in all MaST schools there had been a move away from more traditional ways of teaching, for example using text books and worksheets, towards practical, investigative, creative and problem solving approaches. In many cases, activities had been delivered in a real life context and they had included discussion, pupil interaction and pupils working in groups and pairs. In one school, there was now a focus on the use of 'rich tasks' which included investigation and a range of different elements of mathematics and in future the school planned to use one rich task every week with each year group. One Cohort 1 MaST described these approaches as 'trying to get children involved in the learning in a much more active way' and another reported that: 'Learning in mathematics is relevant, active and fun now' (Cohort 2 MaST).

Several MaSTs reported running **Mathematics Challenges or off-timetable Mathematics Days or Weeks** in which dedicated time was given up to pupils undertaking investigative mathematics work in groups. In some cases, pupils had worked together in cross-age groups. Activities were designed to be fun and included educational computer games, puzzles, games requiring mental arithmetic such as darts and snooker, and outdoor activities. These types of activities helped pupils to understand that mathematics is 'everywhere'. Other MaSTs had run themed projects involving mathematics, for example related to enterprise or healthy eating.

MaSTs also reported an increased focus in their and colleagues' lessons on:

- risk taking and ‘thinking outside of the box’
- using questioning and getting pupils to explain their thinking (including ‘talking for learning’) which deepens understanding of core concepts
- mental mathematics (for example two MaSTs reported using mental and oral starters at the beginning of lessons to instill an understanding of mathematical concepts such as place value and to tackle misconceptions)
- developing pupils’ reasoning and understanding, for example spotting differences and patterns
- teaching pupils strategies for quicker ways of getting answers
- tackling misconceptions head on and getting pupils to explain why something is wrong
- progression in mathematics through the year groups and Key Stages
- using visual aids, games, quizzes and cards with pictures and symbols.

Teachers reported **purchasing, and the greater use of, a range of practical and physical resources** such as: Numicon, number lines, dice, mathematics mats, place value cards and trundle wheels. They commented that, in the past, these resources would primarily have been used by pupils with less secure understanding but they were now being used by pupils of all ages and abilities. MaSTs also reported greater use of interactive white boards, video clips and ICT. Some MaSTs reported using resources from websites such as NRICH (which included Convince Me! Challenges) and purchasing resources such as Be a Mathematician (BEAM), Maths Made Easy and other mental mathematics resources.

A number of MaSTs reported a greater use of the outdoor environment to facilitate creative and investigative sessions. For example, one MaST had set up an outdoor mathematics area and another had developed a mathematics trail in the playground. Several MaSTs had led the introduction of ‘Working Walls’ or ‘Learning Wall Boards’ in all classrooms. In some cases they were child-led with pupils putting up prompts, for example number lines, to help them with their learning.

Examples of fun, practical exercises that MaSTs had successfully introduced into their own classroom and then disseminated to colleagues included:

- children weighing themselves and calculating what they would cost if they were made of different materials such as chocolate or coins
- problem-solving challenges, for example looking at different ways of colouring in an Easter egg
- a Christmas themed reindeer race which used probability to calculate the best reindeer to back

- an advent calendar for mathematics with a mathematics problem every day for the 24 days leading up to Christmas
- writing stories about numbers
- building brick towers to gain an understanding of dimensions
- observing shadows and measuring how they changed over a day
- gaining an understanding of temperature by using methods and materials (e.g. cling film) to try to stop a snowman melting
- using digital cameras to look for right angles in the natural environment
- using number lines in the playground to learn decimals, fractions and percentages
- sharing out imitation pizzas, drinks and crisps to understand fractions.

In a number of schools, new strategies introduced in mathematics had also, deliberately, supported the development of pupils' literacy skills. One MaST reported that pupils were being asked to read through problems and to write down their thoughts on how they might be tackled. Other MaSTs commented that an increased focus on paired and group work had increased pupils' oral language and communication skills, alongside their skills in mathematics.

The views of HEI and local authority deliverers

HEI and local authority deliverers corroborated the views of MaSTs and their colleagues, reporting very strong impacts in terms of MaSTs' pedagogy and on the quality of their own teaching. In many cases, the leadership of mathematics within their school was also reported to have improved. MaSTs were reported to speak confidently about their knowledge and understanding of mathematics teaching and learning and felt that they had some degree of specialism in this area. Impacts had been seen for less experienced teachers as well as those who had been mathematics subject leaders for some years and who had attended a lot of professional development in the past.

They do all seem to be much more aware of the pedagogical issues of teaching mathematics and that seems to be a huge leap...they are moving away from a kind of restrained pedagogy and thinking more about conceptual understanding.

(HEI consultee)

HEI and local authority deliverers felt that the MaSTs had developed a range of effective and varied pedagogies for teaching mathematics, including:

- increased understanding of the most effective ways of teaching mathematics (including from the wider research) and ways to make teaching more interesting and varied (sometimes challenging previously held entrenched beliefs)
- developments in teachers' pedagogy and classroom practice including:
 - knowing which approaches to use in which circumstances and an increased willingness to try things out and take risks
 - the use of apparatus, equipment and other practical resources and materials
 - the use of models and visual images
 - increased use of exploratory, problem solving, open-ended investigative approaches and practical work in their lessons (and less use of worksheets)
 - the improved use of mathematical talk and of the precise mathematical vocabulary
 - the improved use of questioning techniques and facilitating pupil talk and guided reasoning
 - making learning enjoyable and fun and skilled use of enactive representation
 - exploring links between mathematics topics and with other subjects
 - the effective use of outdoor space to teach mathematics.

Like the MaSTs themselves, HEIs and local authorities reported that teachers had become more confident in encouraging pupils to think mathematically, to learn about processes as well as facts, and to allow children to lead their own learning. In many cases, HEIs and local authorities felt that this had contributed directly to improvements in standards and the quality of teaching.

5.1.2 Impacts on teachers' ability to meet the varying needs of learners

In addition to more general developments in MaSTs' teaching practice, the research findings suggest that MaSTs had become increasingly proficient in differentiating their teaching approaches to accommodate learners with varying learning needs.

Findings from the teacher surveys

Headteachers were also asked to what extent their teacher's participation in the programme had made a difference to their confidence to teach mathematics to a

range of abilities, and their use of a broad range of teaching approaches and materials. The findings are presented in Table 5.3 below:

Table 5.3 Headteachers' views on extent of impact of MaST Programme on participating teachers' confidence and use of teaching approaches and materials

	To a great extent		To some extent		Not at all		Don't know	No response	Total
	1	2	3	4	5				
	%	%	%	%	%	%	%	%	%
Confidence to teach mathematics to a range of abilities	43	38	13	3	1		1	1	100
Use of a broad range of teaching approaches and materials	54	32	11	2	0		1	1	100
N = 399									

Source: NFER postal survey of Headteachers, 2012

Due to percentages being rounded to the nearest integer, they may not sum to 100

Table 5.3 shows that **most headteachers reported that the programme had impacted on their teacher's confidence to teach mathematics to a range of abilities, with a large majority (81 per cent) responding with a 1 or 2.** Headteachers were **even more positive about the impact of the programme on teachers' use of a broad range of teaching approaches and materials**, with, again, a large majority (86 per cent) responding with a 1 or 2.

Headteachers were also asked to what extent their **MaST's participation in the programme had made a difference to their capacity to improve pupil achievement.** Answering on the same five-point scale, the vast majority (84 per cent) responded with a 1 ('to a great extent') or a 2, with about half (47 per cent) responding 'to a great extent'.

The views of pupils

Further insights on teaching approaches were obtained from the pupils themselves. The research included **questionnaire surveys of pupils** in MaST schools and in comparison schools in June 2012, the endpoint of the programme. The results below

derive from the Key Stage 2 pupil questionnaire, to which a sample of 2,735 pupils in MaST schools and 1,529 pupils in comparison schools gave responses.

The children were asked about the **frequency with which they undertook a variety of mathematics activities**, of the kind that might be expected to increase with teachers' participation in the MaST Programme. They answered using a five-point scale: 'All the time', 'Most of the time', 'Sometimes', 'Hardly ever' or 'Never'. Since a variety of activities was covered, it is relatively unlikely that many would attract the response 'All the time'. To take account of this, a mean frequency was calculated on a scale of 1-5 and these means were used to compare the two groups, in preference to the percentage selecting each option.

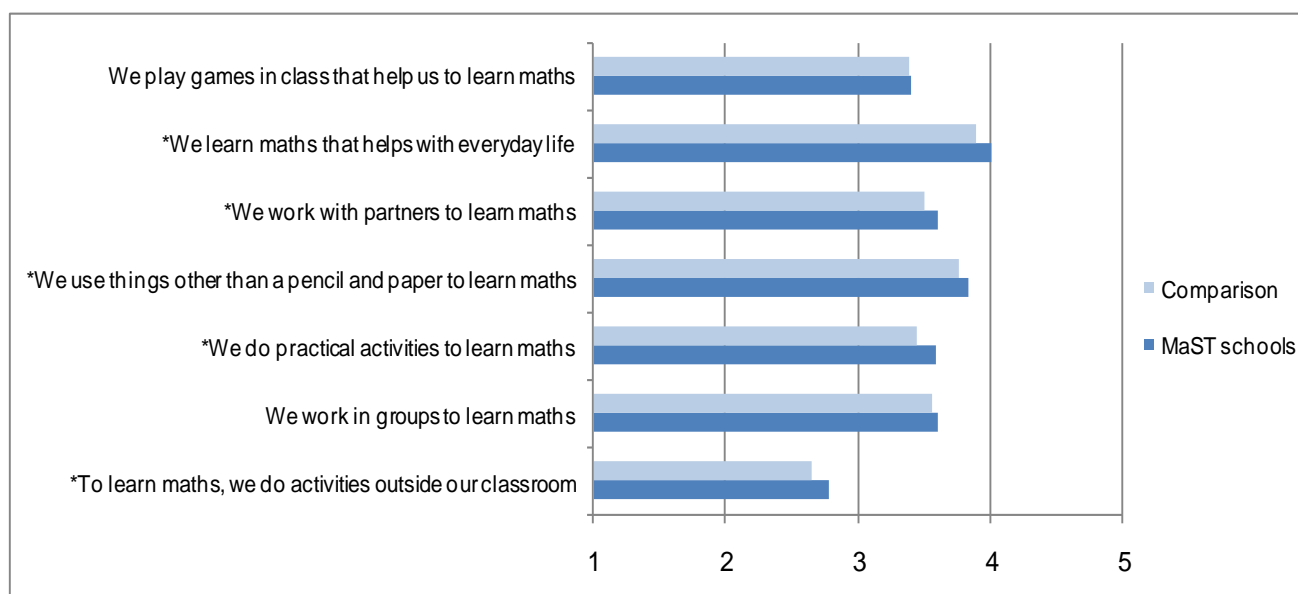
The analysis revealed significant differences between MaST pupils and comparison pupils in five out of the seven activities investigated, with **pupils of MaSTs recording significantly greater frequency** in the following:

- 'To learn mathematics, we do activities outside our classroom (such as in the playground or the computer room)'
- 'We do practical activities to learn mathematics (such as using measuring scales, measuring tapes, rulers or stop-watches)'
- 'We use things other than a pencil and paper to learn mathematics (such as calculators, cubes, number lines or number grids)'
- 'We work with partners to learn mathematics'
- 'We learn mathematics that helps with everyday life (such as money and counting)'.

The activities for which there was no significant difference between the two groups of pupils were 'We work in groups to learn mathematics' and 'We play games in class that help us to learn mathematics' (see Tables E.12-E.18 in Appendix E).

Figure 5.1 illustrates the mean frequency calculated for all seven activities for both groups. It shows that the differences were slight, but those that were nevertheless shown to be statistically significant have been marked with an asterisk.

Figure 5.1 Mean frequency of mathematics activities reported by Key Stage 2 pupils



Source: NFER postal survey of Key Stage 2 pupils, 2012

When these findings are compared with the MaSTs' views in Table 5.1, it can be seen that the **pupils' perceptions of the widening range of mathematics activities offered to them support their teachers' opinions.**

Pupils in MaST and comparison schools were asked the same questions in an earlier survey at the beginning of the school year, in autumn 2011, and the findings were reported in our Interim Report 3. Comparisons between the two time points must be made with caution, as individual pupils were not tracked between the two surveys, so the samples at the two time points are not identical.

At the time of the earlier survey, the only activity that was significantly more frequent for MaSTs' pupils was 'We do practical activities to learn mathematics (such as using measuring scales, measuring tapes, rulers or stop-watches)'. Therefore, the more recent findings suggest that towards the end of the programme there were **significant impacts on MaSTs in terms of them adopting a wider range of teaching approaches and materials.**

Findings from the case studies

Case-study MaSTs and their colleagues also reported that the programme had given MaSTs a **greater understanding of how pupils' learn, as well as an improved ability to gauge pupils' understanding of mathematics**. As a result, MaSTs reported that they felt a greater sense of freedom to implement strategies that would benefit the children rather than adhering rigidly to more traditional lesson plans. MaSTs also reported that they were increasingly child-led when planning and delivering mathematics lessons. For example, MaSTs reported that they now placed greater emphasis on letting children solve problems for themselves. MaSTs reported that pupils had responded well to this approach and now had a real thirst for understanding mathematical processes as well as reaching the right answer.

I'm much more aware of children as learners... not all children like mathematics, and not all think they are good at mathematics... it's about getting them to think differently about mathematics.

(Cohort 1 MaST)

Case-study participants reported that children with a less secure understanding of mathematics responded well to the practical, interactive and visual nature of activities promoted through the MaST Programme, benefiting from the flexibility of investigations and discussion-based activities, which appealed to many different learning styles. MaSTs felt that the approaches promoted through the programme had 'levelled the playing field' for pupils across the ability range.

One of my least able children was the most articulate in terms of planning the work... to have the confidence to say to the group, "this is what I've done and this is why I've done it and this is what I think the answer is" was just so far outside her comfort zone before we did those activities.

(Cohort 2 Headteacher)

Despite the positive impacts on children facing more difficulties with mathematics observed by participants, MaSTs felt that there was still room for further development in meeting the varying needs of this group of learners, particularly where there were gaps in the foundations of children's mathematical knowledge. This was, therefore, a priority for MaSTs in the future.

The views of HEI and local authority deliverers

HEI and local authority deliverers reported that MaSTs had gained a greater insight into students' learning processes as they engaged with mathematics themselves, and had become more thoughtful practitioners as a consequence of this. Deliverers felt that MaSTs were now more able to target their teaching to pupils with varying needs. This included providing greater challenge for more able students, and better focused support for those who found mathematics more difficult.

They've got a very sound basis for justifying an approach or for interpreting children's learning in a particular way and, on that basis, identifying what needs to happen next...The confidence that that knowledge gives is quote empowering for them.

(HEI consultee)

In particular, HEI and local authority deliverers noted that MaSTs had developed:

- a better understanding of how children learn mathematics (e.g. from wider research) and more focus on learning and less on didactic teaching
- an increased understanding of why children under-achieve and how to provide more targeted strategies to get them to improve
- understanding of progression and confidence to better sequence learning to build on pupils' current learning and to spot misconceptions and put in place actions to overcome barriers
- improved accuracy in the assessment of pupil progress.

5.2 Teachers' confidence in their subject knowledge of mathematics across the Key Stages

MaSTs responding to the survey were asked to rate their confidence in their mathematics subject knowledge across the Key Stages of the primary curriculum and beyond. Participating teachers were presented with a five point scale where 1 was 'very confident' and 5 was 'not at all confident', and were asked to decide where they positioned themselves within this spectrum. The responses given by MaSTs in the endpoint survey are presented in Table 5.4.

Table 5.4 MaSTs' confidence in their subject knowledge of mathematics across the Key Stages – endpoint survey

	Very confident		Fairly confident		Not at all confident		Don't know	No response	Total
	1	2	3	4	5				
	%	%	%	%	%				
Early Years Foundation Stage	18	23	35	17	6	1	2	100	
Key Stage 1	41	32	22	3	1	0	1	100	
Key Stage 2	73	19	7	0	0	0	1	100	
Key Stage 3	7	22	26	18	14	9	4	100	
Key Stage 4	2	6	12	19	40	17	5	100	
Beyond Key Stage 4	0	2	6	15	52	20	6	100	
N = 324									

Source: NFER postal survey of MaSTs, 2012

Due to percentages being rounded to the nearest integer, they may not sum to 100

Table 5.4 shows that **MaSTs were most confident about their subject knowledge of mathematics at Key Stage 2**, with over nine out of ten teachers (92 per cent) responding with a 1 or a 2, and just under three-quarters (73 per cent) responding with a 1 ('very confident'). The vast majority of MaSTs who participated in the survey were teaching at Key Stage 2 so, not surprisingly, they were most confident about the Key Stage they were most familiar with.

This was followed by Key Stage 1 for which 73 per cent of teachers responded with a 1 or 2 and just over two-fifths (41 per cent) responded with a 1 'very confident'. Percentages for the secondary Key Stages were, as might be expected, much lower. Over half (52 per cent) reported that they were 'not at all confident' about teaching beyond Key Stage 4, which reflects the fact that very few had any experience of this stage.

Additional analysis revealed that, when compared to the baseline, **many MaSTs had gained confidence in their subject knowledge of mathematics across the Key Stages, and at a much greater rate than their counterparts in the comparison group of schools.** The greatest gain was in subject knowledge at Key Stage 2, as can be seen from Table 5.5 below.

Table 5.5 Extent to which teachers' confidence in their subject knowledge of mathematics at Key Stage 2 had changed between the baseline and endpoint surveys

How confident knowledge of mathematics - KS2	Cohort 2 – Baseline %	Cohort 2 – Endpoint %	Difference %	Comparison – Baseline %	Comparison – Endpoint %	Difference %
1 Very confident	42	73	+31	61	69	+8
2	29	19	-10	21	17	-4
3 Fairly confident	18	7	-11	11	10	-1
4	5	0	-5	4	3	-1
5 Not at all confident	4	0	-4	1	1	0
Don't know	0	0	0	1	0	-1
No response	0	1	+1	0	1	+1
Total	100	100		100	100	
	N=415	N=324		N=203	N=240	

Source: NFER postal survey of MaSTs and comparison teachers, 2011-2012

Due to percentages being rounded to the nearest integer, they may not sum to 100

Table 5.5 shows **a considerable increase in MaSTs' confidence in their subject knowledge at Key Stage 2 as the programme has developed**, with an additional one-third (31 per cent) reporting that they felt 'very confident' between the baseline and endpoint surveys. By contrast, there had been an increase of just eight percentage points amongst comparison group of teachers over the same time period.

As discussed above, different MaSTs and comparison groups participated in the research at each time point with a relatively small overlap, and MaSTs reported a considerably lower baseline position than their comparison group counterparts. As such, these findings should be interpreted with caution. Nonetheless, MaSTs' responses are an encouraging indication of marked improvements in their confidence in their Key Stage 2 subject knowledge, suggesting that the MaST Programme has had a positive impact on teachers in this area. This is confirmed by an analysis based only on the 207 MaSTs who participated in both surveys, for whom the increase was highly statistically significant.

Improvements in teachers' confidence were also apparent in other Key Stages (see Tables F.9-F.13 in Appendix F). For example, when collapsing the proportion of 1 ('very confident') and 2 responses, the following gains in confidence were reported:

- Early Years Foundation Stage (MaSTs +18 points, comparison teachers +12 points)
- Key Stage 1 (MaSTs +27 points, comparison teachers +4 points)
- Key Stage 3 (MaSTs +19 points, comparison teachers +3 points)
- Key Stage 4 (MaSTs +6 points, comparison teachers no increase)
- Beyond Key Stage 4 (MaSTs +2 points, comparison teachers no increase).

Headteachers were also asked for their views on whether their MaST's participation in the programme had made a difference to their subject knowledge, both within and outside of the Key Stages that they taught. The findings are presented in Table 5.6.

Table 5.6 Headteachers' views on the impact of the MaST Programme on participating teachers' subject knowledge – endpoint survey

	To a great extent		To some extent		Not at all	Don't know	No response	Total
	1	2	3	4	5			
	%	%	%	%	%	%	%	%
Subject knowledge within the Key Stage that they currently teach	50	36	8	3	1	1	1	100
Subject knowledge within the Key Stage/s they do not currently teach	33	42	15	5	1	2	1	100
N = 399								

Source: NFER postal survey of Headteachers, 2012

Due to percentages being rounded to the nearest integer, they may not sum to 100

Table 5.6 shows that the vast majority of headteachers felt that the programme had positively impacted on their MaSTs' subject knowledge. This was particularly the case within the Key Stage that they currently taught but there was also evidence that the programme was supporting teachers to develop their subject knowledge more widely, within the Key Stage/s that they did not currently teach. These views support those expressed by the MaSTs themselves.

5.2.1 Teachers' confidence in their subject knowledge of mathematics in specific areas of the primary mathematics curriculum

In addition to more general positive views about the impact of the MaST Programme on teachers' subject knowledge, there was evidence that teachers' confidence across many specific areas of primary mathematics had increased.

Findings from the teacher and headteacher surveys

Teachers were asked to what extent they were confident in their subject knowledge of mathematics in seven areas of the primary curriculum *within the Key Stage that they currently taught*. These areas included:

- using and applying mathematics
- counting and understanding number
- knowing and using number facts
- calculating
- understanding shape
- measuring
- handling data.

Again, teachers were asked to rate their level of confidence on a five point scale where 1 was 'very confident' and 5 was 'not at all confident'. **Analysis revealed that, when compared to the baseline, MaSTs had gained confidence at a much greater rate than their counterparts in the comparison group of schools.** The greatest gain was in 'using and applying mathematics', as can be seen from Table 5.7 below.

Table 5.7 Extent to which teachers' confidence in their subject knowledge of 'using and applying' mathematics within the Key Stage they currently teach had changed between the baseline and endpoint surveys

	Cohort 2 – Baseline	Cohort 2 – Endpoint	Difference	Comparison – Baseline	Comparison – Endpoint	Difference
	%	%	%	%	%	%
1 Very confident	15	72	+57	52	62	+10
2	46	26	+20	36	32	-4
3 Fairly confident	33	2	-31	9	6	-3
4	6	0	-6	0	0	0
5 Not at all confident	1	0	-1	0	0	0
No response	0	0	0	1	0	-1
Total	100	100		100	100	
	N=415	N=324		N=203	N=240	

Source: NFER postal survey of MaSTs and comparison teachers, 2011-2012

Due to percentages being rounded to the nearest integer, they may not sum to 100

Table 5.7 shows that the proportion of MaSTs who reported feeling 'very confident' at using and applying mathematics at the endpoint compared to the baseline increased by 57 percentage points. In the same period, the proportion of teachers reporting feeling 'very confident' in the comparison sample increased by 10 percentage points. While the findings suggested that Cohort 2 MaSTs had grown considerably in confidence since the baseline, relative to the comparison group, some caution should be taken when interpreting the findings. For example, we know from the baseline teacher surveys that the Cohort 2 MaSTs tended to be younger, and at an earlier stage in their teaching careers than their counterparts in the comparison schools. Also, at the time of the baseline surveys, a proportionately smaller number of MaSTs held subject leader/coordinator responsibilities. One could also argue that the first survey was not a true baseline in the sense that the MaSTs

had already started the MaST Programme. As a result, they may have been more aware of their own weaknesses/shortcomings which may have resulted in them generally reporting having lower levels of confidence. As a result, it is possible that MaSTs had more 'room for improvement' than their counterparts in comparison schools. Despite these considerations, it seems clear that MaSTs have grown in confidence over the course of the programme.

With the above considerations in mind, improvements were also reported across the other areas (see Tables F.14-F.21 in Appendix F). When collapsing the proportion of 1 ('very confident') and 2 responses, the following gains in confidence were reported (in descending order):

- Measuring (MaSTs +21 points, comparison teachers +1 point)
- Understanding shape (MaSTs +18 points, comparison teachers no increase)
- Handling data (MaSTs +17 points, comparison teachers +3 points).
- Calculating (MaSTs +14 points, comparison teachers +2 points)
- Counting and understanding number (MaSTs +13 points, comparison teachers +2 points).
- Knowing and using number facts (MaSTs +13 points, comparison teachers +2 points).

MaSTs and comparison teachers were asked the same question but this time in relation to the primary Key Stages that they *did not* currently teach. Overall, MaSTs (and to a lesser extent comparison teachers) reported an even greater gain in confidence than had been the case in the Key Stages that they currently taught (see Tables F.22-F.27 in Appendix F). For example, when collapsing the proportion of 1 ('very confident') and 2 responses, the following gains in confidence were reported (in descending order):

- Using and applying mathematics (MaSTs +49 points, comparison teachers +14 points)
- Counting and understanding number (MaSTs +40 points, comparison teachers +10 points)
- Calculating (MaSTs +42 points, comparison teachers +13 points)
- Knowing and using number facts (MaSTs +40 points, comparison teachers +12 points)
- Understanding shape (MaSTs +41 points, comparison teachers +12 points)
- Measuring (MaSTs +40 points, comparison teachers +15 points)
- Handling data (MaSTs +38 points, comparison teachers +15 points).

Furthermore, MaSTs' confidence appears to have continued to increase between the midpoint and endpoint surveys. **This suggests that the programme has had a considerable and ongoing impact on participating Cohort 2 teachers' confidence in their subject knowledge across a range of curriculum areas in Key Stages 1 and 2.**

Findings from the case studies

In general, case-study MaSTs reported that they were confident in their subject knowledge prior to participation in the programme. Therefore, the impacts experienced by MaSTs in this area were not as wide ranging as described in other areas (for example, the effectiveness of their teaching practice). Nonetheless, several of the case-study MaSTs' reported **improvements in their mathematics subject knowledge** as a result of participating in the programme. This applied both to the Key Stages in which MaSTs themselves taught, as well other Key Stages taught within the school. This was particularly notable in instances where MaSTs had worked with colleagues to improve continuity between Key Stages, and to draw out connections and relationships between different mathematics topics.

In particular, MaSTs reported that the programme had enabled them to **address specific areas of weakness** in their own understanding (e.g. algebra, trigonometry). This was particularly true of Cohort 1 MaSTs, who reported that this helped them to feel more assured when teaching these themes, and more confident to share their subject knowledge with others.

MaSTs also felt that the programme had encouraged them to be **increasingly reflective about their subject knowledge**, undertaking, for example, regular knowledge audits and completing their learning log to assess their strengths and weaknesses. This reflective practice was felt to have provided MaSTs with an opportunity to consolidate and enhance their mathematics knowledge, although some local authority consultants noted that use of the learning log in particular had not been consistently applied (particularly in Cohort 2) and that this had diminished the potential for such impacts to be experienced.

I feel much more confident because my subject knowledge has improved. Because my confidence is so much better I think it has made my role as subject coordinator more secure.

(Cohort 2 MaST)

The views of HEIs and local authorities

In general, HEI staff and local authority deliverers held very positive views about the impacts arising from the programme on MaSTs' subject knowledge, suggesting that

the outcomes for MaSTs and schools compared favourably to other forms of continuous professional development (CPD).

I have been in education for about 20 years and this is the project that has had the most impact that I have been involved in. I have seen a really positive impact on teachers themselves, on the school they work in, on individual teachers within those schools.

(HEI consultee)

In particular, HEI and local authority deliverers noted that MaSTs had developed:

- a deeper understanding of mathematics, including use of ‘big ideas’ in the classroom (and with colleagues) and the underlying importance of particular aspects of mathematics
- understanding of progression from Foundation Stage to Key Stage 3 (for example what needs to be taught in year 1 and how it needs to be taught to achieve Level 5 in year 6).

HEI and local authority deliverers also reported considerable impacts on MaSTs’ enjoyment of, and confidence in, their mathematics subject knowledge. As a result, they enjoyed teaching more and were enthusiastic about teaching mathematics. This often included taking risks and experimenting with innovative approaches to teaching mathematics. MaSTs appeared to read widely to inform their classroom practice, challenging themselves and their colleagues to change their thinking and give their teaching a ‘new lease of life’ (Local authority consultant).

More widely, HEI and local authority deliverers observed that MaSTs’ confidence in their mathematics knowledge has enabled them to become more reflective practitioners, with an increased understanding of their strengths and weaknesses and areas for their own personal development. As a result, MaSTs were held in high regard by their peers and this had had a positive impact on their effectiveness in leading subject change.

5.3 Impacts on pupils’ attitudes

The research revealed a number of positive impacts on pupils’ attitudes towards, and confidence in, mathematics as a result of the MaST Programme. Whilst these impacts were most strongly felt by pupils in the MaSTs’ own classes, participants suggested that impacts had begun to emerge more widely, amongst pupils taught by other teachers in the MaSTs’ schools. The findings are discussed in detail in the following sub-sections.

5.3.1 Findings from the teacher surveys

In the view of the MaSTs who participated in the survey, **the MaST Programme had had a positive impact on the attitudes of pupils in their school.** On a five point scale where 1 was 'to a great extent' and 5 was 'not at all', almost three-quarters of MaSTs (72 per cent) gave a 1 or a 2 response to indicate the impact of the programme on pupils' enjoyment of learning mathematics, and just over two-thirds (67 per cent) gave a 1 or 2 response when asked about the impact of the MaST Programme on pupils' *confidence* in learning mathematics (Table B.42 in Appendix B).

5.3.2 Findings from the pupil surveys

Further evidence was obtained by surveying the pupils themselves. The questionnaire surveys of pupils in MaST schools and in comparison schools in June 2012 (endpoint survey) included a number of questions relevant to this area. The pupils were asked about their attitudes towards mathematics, including measures of enjoyment, aspiration and confidence. The analysis sought out significant differences between those pupils taught by MaSTs and those in the comparison schools, at the endpoint of the evaluation.

In many cases, differences between the MaST and comparison samples proved slight and not statistically significant. **The Key Stage 1 questionnaire, which comprised a small number of simple statements such as 'I like mathematics' to gauge enjoyment and 'I am good at mathematics' to indicate confidence, gave rise to no significant differences between the MaST and comparison samples.** Levels of enjoyment and confidence were fairly high among both groups of children, with 64 per cent of children agreeing that they liked mathematics and 59/56 per cent believing they were good at mathematics (see Tables D.3-D.9 in Appendix D). This picture is very similar to that obtained in the previous pupil survey in October 2011 and reported in our Interim Report 3.

The Key Stage 2 questionnaire included a wider range of questions and more answer options, to probe the views of these older children more thoroughly. Similarly to Key Stage 1, there were no significant differences between MaST and comparison pupils in most questions measuring *enjoyment* of mathematics: 'I enjoy mathematics', 'I like to learn new things in mathematics', 'Maths is one of my favourite subjects' and 'I like the way we learn mathematics'. Overall, as with the younger pupils, the attitudes of these Key Stage 2 children towards mathematics were quite positive, with 60-75 per cent of the sample assenting to these statements by selecting 'all the time' or 'most of the time'.

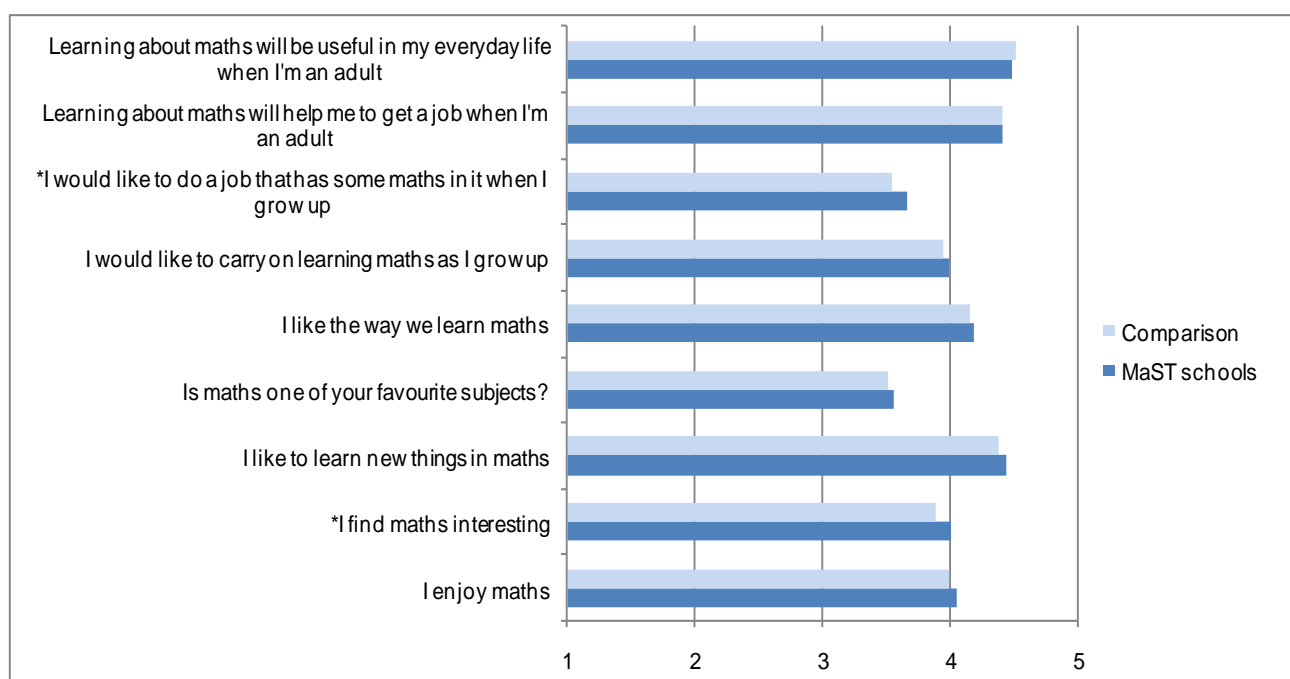
There was, however, one question on *enjoyment* where the MaST pupils gave significantly more positive responses than those in the comparison schools. **'I find**

mathematics interesting’ gave rise to 69 per cent in MaST schools responding ‘all the time’ or ‘most of the time’, as against 64 per cent in comparison schools, and this difference was statistically significant. Further, there was a statistically significant difference in responses to the question about aspirations in mathematics **‘I would like to do a job with some mathematics in it when I grow up’: 32 per cent of MaST pupils responded ‘yes, a lot’ as against 26 per cent in comparison schools.** In fact, there were also slightly higher proportions of MaST pupils who responded positively to all of the *enjoyment* questions, but none of these differences quite attained statistical significance. **The pupil questionnaire at Key Stage 2 therefore yielded some suggestion that children’s views on enjoyment of mathematics backed up those of their teachers** (see Tables E.3-E.11 in Appendix E).

Finally, on aspirations in mathematics, the Key Stage 2 questionnaire revealed no differences between the MaST group and the comparison group for the statements ‘Learning about mathematics will help me to get a job when I’m an adult’ and ‘Learning about mathematics will be useful in my everyday life when I’m an adult’.

Figure 5.2 illustrates the patterns of response to the Key Stage 2 pupil questionnaire by calculating a mean response to each question, on a scale from 1 to 5, with 5 the most positive. The chart shows that differences between the groups were generally not large. Statistically significant findings are marked with an asterisk, in both cases favouring the MaST group.

Figure 5.2 Key Stage 2 pupil mean responses on enjoyment and aspiration



Source: NFER postal survey of KS2 pupils, 2012

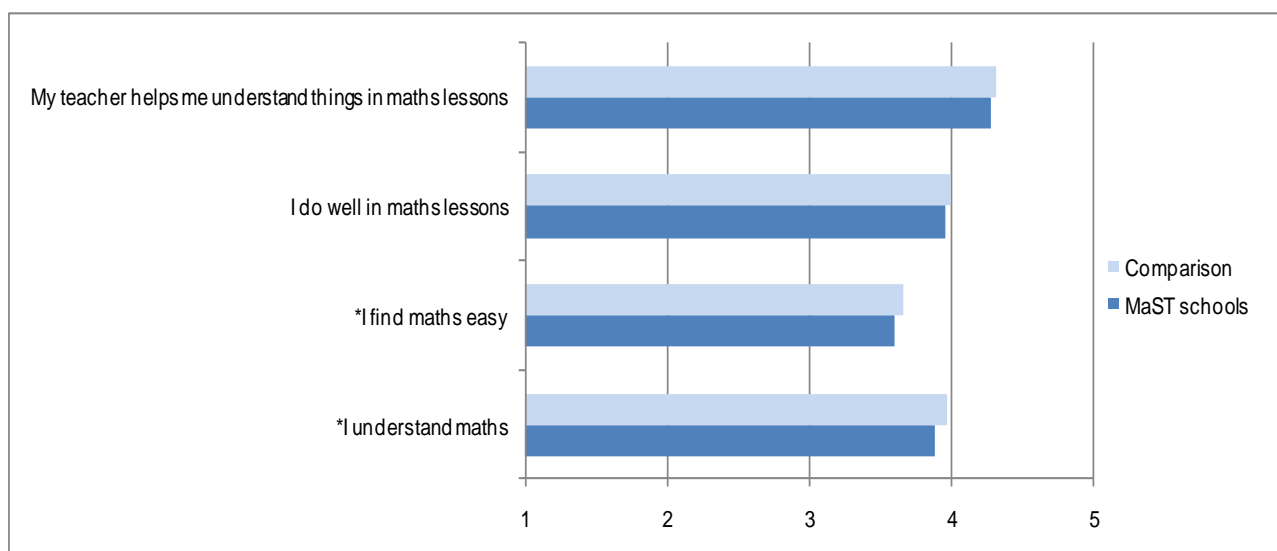
Pupils in MaST and comparison schools were asked the same questions in an earlier survey at the beginning of the school year, in autumn 2011, and the findings were reported in our Interim Report 3. Comparisons between the two time points must be made with caution, as individual pupils were not tracked between the two surveys, so the samples at the two time points are not identical. Nevertheless, it is interesting to note that the earlier survey found a significant difference in favour of MaST pupils for the question ‘I like to learn new things in mathematics’, which has not emerged as significant in this survey. There were no other significant differences in the earlier survey, so the two statements reported above have emerged as significant in the course of the programme.

Overall, however, differences between MaST and comparison pupils at both time points were small. Although there is a suggestion of more positive enjoyment amongst MaST pupils at the endpoint, this is only tentative.

The picture to emerge on the *confidence* questions for Key Stage 2 pupils is somewhat difficult to interpret. Responses to ‘I understand mathematics’ and ‘I find mathematics easy’ were significantly more positive for the *comparison* group. Alongside this, differences were non-significant for ‘I do well in mathematics lessons’ and ‘My teacher helps me understand things in mathematics lessons’, but again the slight differences tended to be in favour of the comparison rather than the MaST group. This suggests that **MaSTs’ pupils’ confidence in their mathematical ability has not yet achieved the levels their teachers perceive.**

The mean responses for these four questions are illustrated in Figure 5.3 and demonstrate the slight differences between the MaST and comparison groups and the overall good levels of confidence amongst these pupils.

Figure 5.3 Key Stage 2 pupil mean responses on confidence



Source: NFER postal survey of Key Stage 2 pupils, 2012

In the autumn 2011 survey of pupils (baseline), no significant differences between MaST and comparison groups were observed on these questions.

5.3.3 Findings from the case studies

Case-study participants strongly reported that pupils' **attitudes and confidence in mathematics** had improved as a result of the MaST Programme. The MaST Programme had introduced changes that meant that teachers were now emphasising that learning new skills is what mattered, not getting the right answer necessarily, so that children were not as afraid to have a go, and they learnt by making mistakes. Pupils' enjoyment of, and confidence in, mathematics had increased as a result of the MaST Programme. Pupils were enjoying mathematics to a greater degree because it had been pitched to their interests and level and the teachers did practical work in the subject that they weren't previously doing. Learning had become more child-led. Pupils were also more likely to learn from one another, demonstrated through, for example, increased levels of peer to peer learning on whole-school mathematics days.

I felt the confidence in the children and their ability to argue their case for their ideas was much stronger.

(Cohort 1 MaST)

Children are notably more enthused and confident in mathematics, and are more willing to talk in mathematics and express themselves. They're not afraid of getting something wrong because that's a way of getting towards the right answer and a better understanding.

(Local authority consultant)

In most cases, impacts were felt to be greatest amongst pupils in MaSTs' own classes, although participants had also observed impacts on pupils in teaching colleagues' classes. This was characterised by an increase in pupils':

- willingness and confidence to 'have a go', to discuss and explain their approaches to solving mathematical problems, and to learn by reflecting on their mistakes
- ability to undertake investigations, to use a range of practical resources and equipment, and to think for themselves about the most appropriate resources to solve mathematical problems
- sense of independence and self-sufficiency in their learning, and confidence to constructively challenge teachers and peers about their perspectives on mathematics

- enjoyment and motivation to learn about mathematics, particularly in relation to themed cross-curricular topics (for example, World War II).

I think [having] happy mathematicians who feel confident [is the most important outcome] because if they don't feel confident, they're not going to succeed are they?

(Cohort 2 MaST)

5.3.4 The views of HEIs and local authorities

HEI and local authority deliverers alike reported that there had been notable impacts on pupils' attitudes towards, and engagement in, mathematics. They reported variously, that pupils enjoyed mathematics more, and that they were more motivated and confident to 'have a go'. Deliverers felt that, in lessons, pupils had developed new skills in mathematical thinking and problem-solving, and had a greater ability to reason and explain mathematical problems with a greater degree of accuracy and understanding of specific mathematical terms and vocabulary. Pupils had become more independent (exemplified, for example, by the ability to choose appropriate mathematical apparatus, and not doing mathematics 'by rote') and better able to work together in groups. They had also become more reflective learners, with a greater awareness of areas where they needed to improve.

It's the general positive independence as well that these pupils are showing the teachers, independence in the way that they think and the way they choose resources.

(HEI consultee)

In addition to impacts related to mathematics, HEI and local authority consultees reported a range of wider impacts. This included, for example, improved behaviour and the development of communication and language skills. The development of learner voice was seen as a critical impact: pupils now had a greater say in their mathematical learning, and felt more valued by their teachers.

Linked to pupils' increased confidence and positive attitude to mathematics was **evidence of a 'can do' approach** and 'the belief that anyone could be a good mathematician (Independent mathematics consultant). Some pupils were even asking for additional work.

Consultees also commented on **pupils' greater use of appropriate mathematics language and vocabulary** (often as a result of an increased emphasis on 'pupil talk') and **their improved skills in problem solving and in undertaking open ended tasks**. Pupils were becoming much **better at critically reflecting upon the**

activities that they had undertaken and how they had progressed and on their own learning.

5.4 Impacts on pupils' attainment, skills and capabilities

This section explores the impact of the MaST Programme on the attainment, skills and capabilities of pupils. First, it explores the statistical evidence for the impact on attainment using data from the National Pupil Database (NPD). Second, it explores the perceptions of consultees collected through the survey and interview data.

5.4.1 Multilevel modelling results

The aim of the analysis was to estimate the impact of the MaST Programme on the attainment of pupils at Key Stage 1 and Key Stage 2 in Cohort 1 schools. The analysis compared the results of pupils in MaST schools to the performance of pupils in other schools. Prior to this analysis propensity score matching was used to remove any pupils/schools with characteristics that either only appeared in the MaST group or only appeared in the comparison group. Full details of the analyses undertaken can be found in the technical appendices. The following outcomes were analysed:

- Key Stage 1 mathematics teacher assessments
- Key Stage 2 mathematics test results

Both of these outcomes (which were in the form of sublevels) were converted into point scores where six points is equivalent to a difference of 1 level. The comparison between pupils in Cohort 1 MaST schools and pupils in other non-MaST schools¹² was made both for 2009 and 2011 results. The aim of the analysis was to discover if there were significant differences between these groups of schools in terms of the rate of progress between 2009 and 2011.

Analysis showed that once differences in background characteristics were taken account of:

- for Key Stage 1 mathematics, MaST Cohort 1 schools had significantly lower achievement in 2009 compared to comparison schools. Although statistically significant this difference was actually very slight; just 0.11 points on average. The gap between MaST and other schools narrowed by 0.04 points by 2011, however, this change was not statistically significant
- for Key Stage 2 mathematics there was no significant difference between MaST schools and other schools in 2009. Additionally the difference in the

¹² Cohort 2 schools are excluded from the comparison group.

rate of change in results between 2009 and 2011 was not statistically significant.

- **The findings suggest that that involvement of at least one teacher in a school in Cohort 1 of the MaST Programme has not yet had a significant impact upon the attainment of pupils at Key Stage 1 or Key Stage 2.**
- Further analysis was undertaken to explore whether an impact could be detected where the MaST was actually teaching the same year group as those pupils being assessed at Key Stage 1 and Key Stage 2. However, this analysis did not find evidence of any difference between schools where the MaST was teaching years 1 and 2 or years 5 and 6.

The lack of conclusive statistical evidence on the impact of the programme on pupil attainment may be influenced by a number of factors. The period of time over which attainment data was analysed was relatively short and it may take longer for impact to become apparent (e.g. as teachers consolidate their new skills and/or disseminate these more widely amongst colleagues, or if pupils perform consistently better in later Key Stage tests as a result of the earlier intervention). Evidence from the case studies also suggests a view from some MaSTs and their colleagues that the skills acquired by pupils as a result of the programme were not always assessed in the national tests, and therefore, perceived improvements in pupils' mathematical abilities did not necessarily translate into improved exam results. Moreover, many consultees interviewed as part of the evaluation reported that MaST-school pupils were better able to tackle mathematical problems in a range of contexts than they were prior to their teachers' becoming involved in the programme. If true, it seems likely that their enhanced understanding and appreciation for mathematics is likely to lead to an improved aptitude for and fluency in mathematics in later life. The results contrast with the strength of the findings from the survey and case-study research which are presented below.

5.4.2 The findings from the surveys

MaSTs and comparison group teachers were asked what progress, on average, the pupils in their class had made over the last full school year. **Almost three-quarters of MaSTs (72 per cent) responded that their pupils' progress had been 'considerably better' or 'somewhat better' than expected, with just under one-quarter (24 per cent) reporting that progress had been 'considerably better'.** None of the MaSTs reported that their pupils had made 'somewhat below the expected progress' (see Table B.35 in Appendix B). Similar responses were given by comparison teachers, but MaSTs' responses represented a notable improvement to those collected at the baseline, when only seven per cent of respondents said progress was 'considerably better than expected' (see Table F.68 in Appendix F).

MaSTs also appeared to indicate that improvements and progress in pupils' achievement could be largely attributed to the MaST Programme itself. On a five point scale where 1 was 'to a great extent' and 5 was 'not at all', just under three-fifths (59 per cent) of MaSTs gave a 1 or a 2 response to impact of the MaST Programme on pupils' progress in mathematics, and 55 per cent gave a 1 or 2 response when asked about the impact on pupils' attainment in mathematics.

The most commonly mentioned reasons for pupils' achievement and progress in mathematics were: teachers developing an increased understanding and knowledge of mathematics (10 per cent), greater focus on 'using and applying' mathematics (six per cent), and greater use of practical resources and activities (six per cent). A further six per cent, however, reported that pupils had achieved above the expected progress as a result of cohort differences (see Table B.36 in Appendix B).

5.4.3 Findings from the case studies

Alongside improvements in pupils' attitudes and confidence, case-study participants reported that there had also been considerable impacts on pupils' skills and capabilities in mathematics. MaSTs reported that pupils were now **much more aware of their own personal targets in mathematics** and were considerably more independent in their approaches to learning. For example, children now followed their own lines of enquiry in lessons, without the MaST spelling out the learning objectives at the beginning of the session. Pupils themselves reported that they liked having different ways of learning mathematics, rather than just learning out of text books. They understood why they were learning mathematics and felt they were improving, even though their lessons were getting harder.

MaSTs also observed that pupils were more content to verbalise their experiences of learning mathematics and were therefore more confident to undertake questioning and reasoning activities and use descriptive language. MaSTs also reported that some of the group work undertaken by pupils had increased confidence: for example, asking pupils to come up with answers in a group rather than as an individual was felt to promote confidence amongst children who might not otherwise put themselves forward. Pupils themselves reported that they now liked mathematics more because it was practical and fun, and because they were not embarrassed about making mistakes. They commented that their teachers allowed them to work at their own pace, so they could feel confident about what they were learning.

They [pupils] love numeracy. They get some real enthusiasm from their teachers. They are developing a range of skills and confidence.

(Cohort 2 MaST)

A lot of children now would say to you that they enjoy it [mathematics], the investigative approaches have made mathematics learning much more enjoyable.

(Cohort 2 Headteacher)

Pupils appeared to echo the views of their teachers, reporting that they were more confident in their mathematical ability and that they were learning more, despite finding mathematics more difficult than they had done in previous years.

Whilst the greatest reported impacts on pupils related to their attitudes and capabilities, some case-study participants cautiously indicated that the MaST Programme may have resulted in **moderate impacts on pupil attainment**. However, participants emphasised that there were a wide range of measures aimed at improving pupil attainment in mathematics: the MaST Programme was just one of these measures and positive changes in pupils' abilities should not, therefore, be viewed in isolation. In addition, several schools suggested that it was too early to measure impact in relation to attainment: in some cases, this was because schools felt that impacts on attainment were only likely to emerge in the longer-term (in the most marked example of this, a MaST reported that fostering pupils' positive disposition towards mathematics in Key Stage 1 might only translate into improvements in achievement at GCSE level and beyond). In other cases, schools felt that it was difficult to identify positive impacts due to differences in the ability and skills of different cohorts of pupils.

The attainment in school has risen dramatically. I know our mathematics has improved significantly, we can see that in our mathematics results over the last few years... it's made a massive impact on the children's learning, which ultimately is what the MaST course is about.

(Cohort 2 MaST)

I think on [the MaST's] own pupils there's been a tremendous impact, the children in her mathematics group, because she has the lower ability group, and they've all made very good progress, most of them much better than would be expected.

(Cohort 2 Headteacher)

Participants were less convinced, however, that such examples of achievement had been reflected in national Key Stage test results. One headteacher suggested that this might be because the skills fostered throughout the MaST Programme (e.g. improved approaches to mathematics and mathematical thinking) are not necessarily

essential for success in national tests. As a result, national tests may not be a fair reflection of the skills developed as part of the MaST Programme.

I'm now left this year really torn... the mathematics results have gone down significantly this year. I have to do some investigation about where they've gone down and whether it is the group that have done a lot of activities, that then haven't transferred their learning across into the SATS, or whether it's another group that's really failed to take off.

(Cohort 1 Headteacher)

Several MaSTs reported that pupils were making **high levels of individual progress** in mathematics. Case-study participants reported examples, for instance, of pupils who were vulnerable to underachievement making greater progress than expected, and of pupils who exhibited preferences towards kinaesthetic learning benefiting from the use of visualisation techniques promoted through the MaST Programme.

5.4.4 The views of HEIs and local authorities

Evidence from consultees suggests that the above impacts are leading, in many cases, to the improved progress and raised standards within MaSTs' own classrooms and a narrowing of gaps in attainment. However, these raised standards are not always impacting on Key Stage results - this depends on what year group the MaST teaches. If the MaST is teaching year 6, for example, then there is more likelihood that the Key Stage 2 results will be impacted. Several consultees commented on the improved performance in mathematics of pupils within the MaSTs' class but many felt cautious about attributing positive changes solely to the MaST Programme. As several consultees commented:

As an authority we have year on year tracked Key Stage 1 and 2 results in schools where we have MaSTs. These results show improvement over time where the MaST has been allowed to work across school and the work of the MaST has been supported by the headteacher and followed up by them. We have found that in schools where the MaST is also the subject lead the results are better than in those where the MaST is not.

(Local authority consultant)

HEI and local authority deliverers reported that in some schools, there had been substantial increases in attainment in pupils' Key Stage 2 national test results, as well as evidence of greater than anticipated progression between Key Stage 1 and Key Stage 2. Impacts on pupil attainment, however, were not reported as strongly as

associated improvements in engagement, confidence, etc. Consultees were keen to emphasise that that a considerable period of time must elapse for improvements to show up on national test data, and as such it might be too early to say.

Small changes are beginning to be seen but they [MaSTs] feel it will take at least another year to notice concrete [changes] to end of year attainment.

(Local authority consultant)

Very importantly, two HEI consultees commented that the impacts on pupils were likely to be sustainable as they had gained a broader understanding and a great enthusiasm for mathematics. One HEI consultee described how pupils had developed a deeper relational understanding of mathematics (rather than an understanding based on memory recall) and that this impact was sustainable as it was a way of thinking and was not reliant on pupils remembering something.

5.5 Impact of the MaST Programme on collaborative approaches to improving mathematics

The survey findings suggest that the MaST Programme has had some impact on MaSTs' skills and capabilities to work collaboratively with their colleagues. When MaSTs were asked what strategies or approaches had worked well in engaging colleagues with the programme, they appeared to be using **a range of approaches, with the three most frequent being staff meetings (19 per cent); sharing and/or providing resources (11 per cent) and sharing ideas and/or suggestions (10 per cent)** (see Table B.41 in Appendix B).

However, when MaSTs were asked to what extent teaching staff in their school were interested in working collaboratively with them to improve their subject and/or pedagogical knowledge, the findings suggested that **some MaSTs had found it difficult to engage their colleagues in working collaboratively**. Teachers were asked to answer on a scale of 1 to 5 (where 1 was 'to a great extent', 3 was 'to some extent', and 5 was 'not at all' (see Table B.40 in Appendix B). Whilst MaSTs' responses were, overall, positive (and became increasingly so between the baseline and endpoint surveys), two-fifths of the MaSTs surveyed (40 per cent) responded between 'to some extent' and 'not at all'.

Where they had worked collaboratively, specific impacts on teachers had included increased collaboration and sharing of ideas (eight per cent), greater knowledge and understanding of mathematics (six per cent) and improvements in teachers' practice (five per cent).

5.5.1 Impacts on teachers' involvement in, and ability in undertaking, professional development activities: frequency of activity

Findings from the teacher and headteacher surveys

To ascertain teachers' involvement in, and ability undertaking, professional development activities, Cohort 2 MaSTs responding to the survey were asked how frequently they had undertaken a range of professional development activities with colleagues over the last year, and how confident they were in undertaking these activities. The findings for MaSTs are presented in Table 5.8 below.

Table 5.8 Frequency with which MaSTs undertake professional development activities with colleagues – endpoint survey

	Half-termly or more	Termly	Annually	Infrequently	Never	No response	Total
	1	2	3	4	5		
	%	%	%	%	%	%	%
Offering advice to colleagues on mathematics-specific pedagogies (for example an alternative approach to teaching a concept)	45	33	7	14	1	1	100
Supporting colleagues with planning of mathematics lessons	35	30	10	22	2	1	100
Mentoring/coaching another member of staff on mathematics teaching	32	36	14	14	3	1	100
Leading small staff meetings on mathematics-specific issues	32	41	12	11	4	1	100
Leading meetings or discussions with colleagues to review and support their mathematics teaching	27	43	15	11	3	1	100
Leading meetings or discussions with colleagues to review and support their mathematics subject knowledge	26	47	12	11	2	1	100
Offering advice to colleagues on Assessment for Learning in mathematics	24	40	12	19	5	1	100

Observing a colleague's mathematics lesson and providing constructive feedback	15	36	23	14	12	1	100
Mentoring ITT trainees or NQTs that involves a focus on mathematics teaching	16	13	22	18	29	2	100
Being observed teaching where you modelled a teaching approach or aspect of management and organisation	12	37	23	18	9	2	100
Leading a whole-school meeting on mathematics as part of a school closure day	10	17	33	16	22	1	100
Collaborating on a 'lesson study' approach with a colleague (e.g. tackling a mathematics learning and teaching need, teaching and observing others' lessons, then reviewing the outcomes)	7	23	27	24	18	1	100
N = 324							

Source: NFER postal survey of MaSTs, 2012

Due to percentages being rounded to the nearest integer, they may not sum to 100

Table 5.8 shows that activities involving discussions, meetings, training and support to colleagues *outside* of the classroom took place more frequently than activities *inside* the classroom involving collaboration in the context of teaching lessons.

More specifically it shows that:

- the activity that MaSTs were most frequently engaged in was ‘offering advice to colleagues on mathematics-specific pedagogies’ with 45 per cent reporting they did this half-termly or more
- this was followed by ‘supporting colleagues with planning of mathematics lessons, ‘mentoring/coaching another member of staff on mathematics teaching’ and ‘leading small staff meetings on mathematics-specific issues’, with around one-third (35 per cent) of teachers reporting that they engaged in these activities half-termly or more
- the most infrequent activities were ‘collaborating on a ‘lesson study’ approach with a colleague’ and ‘supporting colleagues with planning of mathematics lessons’ (28 per cent and 27 per cent respectively)
- the activities most frequently reported as having ‘never’ been undertaken were ‘leading a whole-school meeting on mathematics as part of a school closure day’ and ‘collaborating on a ‘lesson study’ approach with a colleague’ (22 per cent and 18 per cent respectively) (see Table B.33 in Appendix B).

Additional analysis revealed that, when compared to the baseline, many MaSTs were now undertaking these professional development activities with colleagues more frequently, and in some cases, considerably more frequently than their counterparts in the comparison group of schools. When collapsing the proportion of 1 (‘half-termly or more’) and 2 (‘termly’) responses, the biggest gains in frequency of activity were reported in the following five areas (in descending order):

- offering advice to colleagues on mathematics-specific pedagogies (MaSTs +48 points, comparison +12 points)
- mentoring/coaching another member of staff on mathematics teaching (MaSTs +47 points, comparison +7 points)
- leading meetings or discussions with colleagues to review and support their mathematics subject knowledge (MaSTs +46 points, comparison +9 points)
- leading meetings or discussions with colleagues to review and support their mathematics teaching (MaSTs +41 points, comparison +10 points)
- leading small staff meetings on mathematics-specific issues (MaSTs +38 points, comparison +5 points) (see Tables F.45-F.56 in Appendix F).

Overall, greater frequency of activity was reported across the board, suggesting that many Cohort 2 MaSTs were now engaging more frequently in collaborative professional development activities than they were at the time of the baseline survey.

Findings from the case studies

The findings from the case studies also showed that progress had been made within the case-study schools, with MaSTs introducing new activities and teaching approaches both within their own classroom and to other colleagues across the school. **The majority of case-study MaSTs had worked with staff across the school** whilst also working with a small number of colleagues individually or in groups (i.e. by year group or Key Stage).

The range of professional development activities that MaSTs had undertaken with all teachers in case-study schools included:

- running sessions at staff meetings for all staff
- training and information sharing at INSET days (either taking up a whole INSET or running a MaST session as part of an INSET)
- twilight training sessions for teachers or teaching assistants.

As well as sharing learning and resources at meetings and INSETs, MaSTs had shared successful activities with other teachers in other ways, such as via the school's intranet.

In addition, a number of case-study MaSTs had undertaken activities such as: **mentoring and coaching, lesson observation, lesson studies, joint planning and sharing of resources** with individual and groups of teachers (including student teachers and NQTs). A small number of MaSTs had solely used these approaches with individuals or groups of teachers rather than working at a whole school level. In some schools, MaSTs had been successful in embedding the lesson study approach which was now being transferred to other subject areas. A key aspect of lesson study is its focus on children's responses to the lesson which has been particularly valued by MaSTs.

MaSTs reported working with both teachers struggling with particular aspects of mathematics as well as strong leaders who could help them promote new thinking in mathematics and exert some influence. In some cases, teachers had been selected for the MaST to work with and, in other cases, MaSTs had worked with willing volunteers.

One headteacher added a cautionary note in terms of MaSTs working with colleagues commenting that there needed to be a balance between MaSTs supporting colleagues and enriching the learning experiences of their own pupils:

For the school the balance is that we don't want to lose [name of MaST] and her good class teaching, and balancing that with sharing that knowledge with everyone else. It's a very fine balance because if she is out of class too much it's a detriment to her class

(Cohort 2 Headteacher)

Six MaSTs had also run **workshops with parents or development leaflets for parents**. The aim had been to make parents more aware of the strategies that were taught in schools for learning mathematics so that they were better able to support, and were more confident in supporting, their child with homework. As a Cohort 1 MaST commented:

They [the workshops] showed parents how they could help at home, They enjoyed doing that and found it useful...parents are key in teaching mathematics. If they're teaching them the right way at home, and not teaching them something different, that's really important.

In two schools, the MaST Programme had led to, or supported a move towards, mathematics being a priority in the School Development Plan (SDP) or School Improvement Plan (SIP). In another, an Action Plan for Mathematics was being developed and, in a fourth, the SDP now had a focus on open-ended problem solving and investigative work and group work.

5.5.2 Impacts on teachers' involvement in, and ability in undertaking, professional development activities: confidence

Findings from the teacher and headteacher surveys

The confidence of MaSTs responding to the survey in undertaking the same activities detailed in section 5.5.1 was measured on a five point scale, where 1 was 'very confident', 3 was 'fairly confident', and 5 was 'not at all confident'. Again, the findings were generally very positive, with the majority of respondents (more than 50 per cent) responding with a 1 or 2 for each of the activities explored (see Table B.34 in Appendix B). When compared to the baseline, many MaSTs appeared to be more confident in undertaking these professional development activities with colleagues. When collapsing the proportion of 1 ('very confident') and 2 responses, the biggest gains in confidence were reported in the following five areas (in descending order):

- leading meetings or discussions with colleagues to review and support their mathematics teaching (MaSTs +48 points, comparison +11 points)

- offering advice to colleagues on mathematics-specific pedagogies (MaSTs +47 points, comparison +12 points)
- leading meetings or discussions with colleagues to review and support their mathematics subject knowledge (MaSTs +46 points, comparison +9 points)
- mentoring/coaching another member of staff on mathematics teaching (MaSTs +43 points, comparison +4 points)
- offering advice for colleagues on Assessment for Learning in mathematics (MaSTs +41 points, comparison +16 points) (see Tables F.56-F.67 in Appendix F).

The findings above suggested that, since the baseline, MaSTs had not only engaged more frequently in collaborative approaches to improving mathematics, they had also gained in confidence when supporting other colleagues.

Headteachers were also asked a number of questions designed to explore whether they shared MaSTs' perceptions of their effectiveness and impact in engaging other staff in collaborative development activities. For example, headteachers were asked to what extent the frequency of selected collaborative activities had increased as a result of the MaST Programme. The findings are presented in Table 5.9 below.

Table 5.9 Headteachers' views on extent to which the frequency of collaborative professional development activities had increased as a result of the programme

Activity	To a great extent		To some extent		Not at all	Don't know	No response	Total
	1	2	3	4	5			
	%	%	%	%	%	%	%	%
One-to-one work with staff on mathematics teaching	17	42	29	8	2	1	2	100
Small group work/meetings on mathematics teaching	16	41	31	6	3	1	1	100
Whole staff meetings on mathematics teaching	33	41	18	4	3	1	1	100
Shadowing and observations to develop mathematics teaching	16	40	27	10	5	1	2	100
N = 399								

Source: NFER postal survey of Headteachers, 2012

Due to percentages being rounded to the nearest integer, they may not sum to 100

Table 5.9 shows that:

- the vast majority of headteachers considered the programme to have impacted on all four areas of activity at least 'to some extent'
- headteachers thought the programme had had the greatest impact on the frequency of 'whole staff meetings on mathematics teaching', with 33 per cent reporting an impact 'to a great extent'.

Headteachers were also asked to what extent they thought their MaST's participation in the programme had made a difference to their capacity to support colleagues' teaching of mathematics. Responding on a five point scale, where 1 was 'to a great

extent', 3 was 'to some extent', and 5 was 'not at all', the vast majority (84 per cent) responded with a 1 or 2, and over half (51 per cent) responded with 1 ('to a great extent'). Taken together, the findings suggested that most headteachers agreed with MaSTs that, as a result of the programme, they now had greater involvement in, and ability in undertaking, professional development activities (see Table A.9 in Appendix A).

Findings from the case studies

Several of the case-study MaSTs felt that their **confidence to support colleagues had improved as a result of participating in the MaST Programme**. As a result, they felt more able and better equipped to provide this support. However, there was some variation in the ways that MaSTs appeared to have experienced this impact.

Some teachers, for example, felt that the MaST Programme had **motivated them, and given them licence, to work with a wider range of teaching colleagues**. This included coaching and delivering training on both a formal and informal basis to teachers in different Key Stages. In other cases, MaSTs had been able to work more closely with colleagues with different professional backgrounds: for example, teaching and learning support assistants.

My coaching and mentoring ability has gone from zero to flourishing.

(Cohort 1 MaST)

I worked with two teaching assistants – we have banter across the classroom about mathematics – we've all grown in confidence together, I'm so pleased with the way mathematics goes in the classroom now.

(Cohort 2 MaST)

For others, however, the MaST Programme had primarily enabled them to support colleagues in different ways. MaSTs described, variously, that the programme had **enabled them to support colleagues more sensitively and respond better to their needs and fears** around teaching mathematics.

I've supported colleagues in the past but I've maybe not looked at the different skills involved in coaching versus mentoring and all that kind of thing. From that perspective, it's probably given me a greater understanding about how to approach things and how to develop them in the future, working with the same individual.

(Cohort 2 MaST)

These positive impacts were broadly supported by both headteachers and teaching colleagues, although many suggested that **MaSTs were naturally skilled in this area prior to participation in the programme**. This suggested that, in some cases, the MaST Programme had played an important role in further enhancing MaSTs' existing skills rather than, necessarily, developing new ones. Positive feedback from colleagues about the value of this type of advice and guidance was perceived to further increase MaSTs' confidence in their capacity to support colleagues.

5.6 Impact on standards of teaching and learning and on whole school improvement

5.6.1 Findings from the teacher and headteacher surveys

Teachers were asked to what extent their involvement in the MaST Programme had impacted on a range of areas within their school. The findings are presented in Table 5.10 below.

Table 5.10 Extent to which teachers' involvement in the MaST Programme had impacted on a range of areas in their school - endpoint survey

	To a great extent		To some extent		Not at all		No response	Total
	1	2	3	4	5	Don't know		
	%	%	%	%	%	%	%	%
The priority given to improving attainment and standards in mathematics	27	42	25	4	2	0	0	100
The priority given to improving the quality of mathematics teaching and learning	27	44	23	4	2	0	0	100
The active involvement of the headteacher and senior management team in developing strategies to improve my school's performance in mathematics	23	34	31	7	4	1	1	100
The collaborative working of teachers to improve curricular provision and teaching approaches in mathematics	21	43	28	6	2	1	0	100
Teachers' mathematical knowledge	17	50	29	2	0	1	0	100
The commitment of teaching staff to continually improving the school's performance in mathematics	15	50	27	4	3	1	0	100
Teachers' enthusiasm about mathematics	15	54	26	2	2	0	0	100
The opportunities for teachers to undertake in-school mathematics-specific professional development activity	15	38	34	6	6	1	0	100
Teachers' confidence in teaching mathematics	12	50	33	4	1	0	0	100
The school's engagement with parents on how to help their children with mathematics	8	31	34	17	8	2	0	100
The opportunities for teachers to undertake external mathematics-specific professional development activity	6	19	32	19	19	5	0	100
N = 324								

Source: NFER postal survey of MaSTs, 2012

Due to percentages being rounded to the nearest integer, they may not sum to 100

Table 5.10 shows that, very encouragingly, MaSTs perceived the programme to have positively impacted on many aspects of teaching and learning across their school. Most strongly, MaSTs reported that the programme had impacted on the **priority given to improving the quality of mathematics teaching and learning, and to improving attainment and standards in mathematics**, with 71 per cent and 69 per cent of teachers respectively providing a 1 or 2 response to these areas. Headteachers echoed these views, with 78 per cent and 76 per cent giving a 1 or a 2 response respectively (see Table A.11 in Appendix A).

5.6.2 Findings from the case studies

Many of the case-study participants reported **impacts on the quality of mathematics teaching exhibited by MaSTs' teaching colleagues**. This reflects similar strength of feeling expressed about MaSTs' own teaching practice, although some participants observed that it was difficult, and in some cases too early, to measure the strength of impact felt by colleagues.

In general, participants felt that teaching colleagues had developed a **greater awareness of creative approaches to teaching mathematics**, and encouraged them to take greater risks in planning and delivering lessons. This included, for example, greater use of investigative approaches and enquiry-based learning. Colleagues themselves felt that they were being challenged as teachers to find the best approaches for their pupils, and to question the assumptions they had previously held about teaching mathematics. Case-study participants commonly reported that an increased amount of professional discourse between MaSTs and their colleagues has been critical to raising their **confidence to teach mathematics**.

It challenges you as a teacher... [to think] I could really do this in a much better way. In terms of that challenge to teachers, you can challenge others in the school to think about their own beliefs and whether those beliefs are correct. It's challenging in terms of what you think you know.

(Cohort 1 Teaching Colleague)

My confidence has grown in mathematics, it's no longer a scary word... my confidence has grown because I do feel I can help [pupils] more.

(Cohort 1 Teaching Colleague)

Alongside impacts on individual teaching colleagues' own perspectives and practices, some participants reported that there had been **more deep-seated changes to culture of teaching within their school**. Case-study participants reported a sense that staff attitudes were changing: they were thinking more about what they were teaching, using more creative approaches, and introducing a greater number of practical activities.

It has completely changed teaching practice, the pupil experience has changed – teachers are open to questions, they go with the flow more... there are amazing lessons. You see children have a light bulb moment and it's very rewarding.

(Cohort 1 MaST).

Case-study participants reported that the MaST Programme was beneficial for teaching colleagues of all experience levels. However, HEI and local authority deliverers reported that the nature and scope of impacts on MaSTs' colleagues had depended on a range of factors, including: individual school settings, cultures and priorities (for example, whether mathematics was a focus and the schools was open to different types of CPD); the level of support from the senior leadership team; and the participant's confidence, experience and level of seniority and status within their school.

5.7 Impacts on participating teachers' roles and career progression

In terms of their current role in relation to mathematics, **82 per cent of the MaSTs participating in the endpoint survey were currently the mathematics subject leader/coordinator. However, only 67 per cent reported previously holding this role, suggesting that many had taken on this additional responsibility since starting the programme** (see Tables B.8 and B.9 in Appendix B). By contrast, 92 per cent of comparison teachers reported being their school's mathematics subject leader/coordinator (see Table B.8 in Appendix B). No data was collected on when they took on this responsibility.

Additional evidence was also collected to suggest that the MaST Programme had already benefited or had the potential to benefit teachers' career progression. For example, in response to a question on their role, about three out of ten MaSTs (31 per cent) said that they had been promoted or taken on a new responsibility as a result of their involvement in the MaST Programme (see Table B.11 in Appendix B). Of these MaSTs, almost half (48 per cent) reported they had become the mathematics coordinator. Other key ways in which teachers reported their roles had changed as a result of their involvement in the MaST Programme included:

- becoming a member of the senior management team/leadership team (14 per cent)
- taking on a wider mathematics role (e.g. local authority adviser) (12 per cent)
- coaching/training colleagues (10 per cent)
- becoming a deputy headteacher (10 per cent)
- becoming a headteacher (2 per cent).

5.8 MaSTs' plans for continued work in their own schools

MaSTs responding to the survey were asked to comment on their/their school's plans for the future development of mathematics within their school and how they saw the activities and impacts of the MaST Programme being sustained beyond the funding period (see Table B.49 in Appendix B). Most commonly, teachers' priorities were to focus on:

- developing higher order skills, such as reasoning, problem-solving and mathematical thinking (10 per cent)
- developing verbal reasoning and using the language of mathematics (six per cent)
- leading staff meetings, workshops, INSET sessions and CPD (eight per cent)
- further embedding the learning from the MaST Programme (five per cent)
- developing the mathematics curriculum (five per cent)
- raising the profile of mathematics within the school (five per cent)
- raising pupil attainment (five per cent).

MaSTs involved in the both the surveys and case studies also had a range of plans to develop their work further with other schools. This is explored in detail in Chapter 7.

5.9 Modelling the overall impact on MaSTs

The preceding sections have reported in some detail the responses of MaSTs, their headteachers and their pupils and have commented on the distance travelled between the baseline and endpoint surveys and differences between MaST and comparison teachers.

To determine the impact that can be attributed to the MaST Programme with greater rigour, a multiple regression model was employed. The aim of this was to take into account not only whether respondents were MaSTs or comparison teachers, at baseline or endpoint, but also the background characteristics of the respondents. The model identified significant differences that could be attributed to participation in the MaST Programme, at the same time as any differences attributable to background characteristics. In this way, the multiple regression model controlled for the possible differences in background characteristics between MaST and comparison samples and made it possible to quantify the impact of participation in the programme for the teachers. This made an important contribution to establishing the counterfactual, that is, a measure of what would have happened in the absence of the MaST Programme, an important indicator of impact.

The sample for this analysis was 311 teachers, 209 of them MaSTs and 102 comparison teachers, who completed both baseline and endpoint surveys. The background factors included in the model were: gender, age, number of years of

teaching experience, highest level of qualification in mathematics, year group taught, whether or not the subject leader in mathematics and whether full time or part time.

To conduct this analysis effectively and give meaningful outcomes, the survey questions were grouped together as factors, identified by a factor analysis, to give indicators of a few key impacts. The factors fell into two broad areas of interest: impact on the MaSTs' confidence and self-efficacy; and impact on their collaborative practice.

The outcome of the multiple regression model is a coefficient and a measure of statistical significance. In order to report this in terms that are more readily understood and compared with other studies, this output was converted into an estimate of effect size, a statistic with a range of 0 to 1, which can be positive or negative. In educational studies, effect sizes of up to 0.2 may be considered modest, between 0.2 and 0.5 moderate, and above 0.5 strong.

5.9.1 Impact on the confidence and self-efficacy of MaSTs

The MaST Programme aimed to achieve significant improvements in the ability of teachers to teach mathematics effectively across all aspects of the subject, both within and outside the primary Key Stage in which they were currently teaching. The questionnaires gave a measure of how far the MaSTs believed that this had been achieved. Their views on this were expressed as their confidence in teaching mathematics and their beliefs about their own effectiveness, often described as self-efficacy.

The factor analysis revealed a number of separate dimensions of this, which can be seen in Table 5.11 below.

The multiple regression model identified where there were significant differences between the distance travelled between baseline and endpoint by MaSTs, when compared to the comparison group of teachers. The model also indicated where significant differences existed that were attributable to other factors.

In all of the seven confidence and self-efficacy factors listed below, the model found a **significant positive impact attributable to participation in the MaST Programme**. The estimated effect sizes were relatively high for an educational study, as Table 5.11 shows.

Table 5.11 Confidence and self-efficacy factors and estimated effect sizes

Factor	Estimated effect size
Confidence in teaching Key Stage 1 and early years	0.66
Confidence in teaching Key Stage 2 and above	0.47
Confidence across the range of the mathematics curriculum within own Key Stage	0.44
Confidence across the range of the mathematics curriculum in other Key Stages	0.65
Self-efficacy in progression and assessment (e.g. setting high expectations, integrating assessment, challenging the most able pupils)	0.82
Self-efficacy in making links with mathematics (e.g. mathematics in the real world, connections across the mathematics curriculum)	0.91
Self-efficacy in using a range of teaching approaches (e.g. practical resources).	0.94

MaSTs' confidence in their ability to teach the range of mathematics across the primary Key Stages had improved very significantly more than that of comparison teachers. The gains were moderate for Key Stage 2 and above and for participants' own Key Stage, and stronger for Key Stage 1 and below and outside the participants' own Key Stage. Since more participating teachers were in Key Stage 2 than below, this finding reinforces that there were greater gains in confidence outside the teachers' own Key Stage, rather than within it. It is to be expected that teachers would have greater confidence in the Key Stage with which they were familiar, so the greater increases in less familiar Key Stages is a noteworthy outcome of the programme.

In the factors concerned with self-efficacy, the effect sizes were even more impressive, all of them strong. **This is clear evidence that participation in the MaST Programme has had a very significant positive impact on teachers' self-efficacy as mathematics teachers.**

Few other characteristics emerged as significant in this analysis. In particular, teachers' level of qualification in mathematics before the programme was not a

significant factor in these confidence and self-efficacy outcomes, apart from the one instance below, which is difficult to interpret. The additional variables to emerge as significant were the following:

- increase from baseline to endpoint was highly significant for all factors
- there were significantly greater increases in confidence at teaching Key Stage 1 and early years amongst those who had been teaching for longer and amongst those aged under 35 years
- there were significantly smaller increases in confidence in teaching Key Stage 1 and early years amongst those whose level of qualification in mathematics lay between GCSE and degree level (i.e. most often A-level).

5.9.2 Impact on the collaborative practice of MaSTs

Whilst MaSTs' feelings of confidence and self-efficacy are important, the programme sought also to have an impact upon their practice. Further analysis examined this, and in particular the distance travelled in terms of frequency of collaborative working and support for colleagues in teaching mathematics.

Two factors emerged, corresponding approximately to the distinction introduced above between collaborative activities *outside* the classroom, such as leading staff meetings and giving advice, and those *inside* the classroom, such as lesson study. The outcomes appear in Table 5.12.

Table 5.12 Collaborative practice factors and estimated effect sizes

Factor	Estimated effect size
Collaborative practice: meetings and advice outside the classroom	0.49
Collaborative practice within the classroom	0.40

MaSTs reported an increase in their collaborative practice that was significantly greater than that in comparison schools. Effect sizes were moderate, and support the findings reported above which indicated a greater gain in leading meetings outside the classroom than in lesson study activities within the classroom.

The only other characteristics to emerge as significant in this analysis were:

- increase from baseline to endpoint was highly significant for both factors.

- teachers aged under 35 years made significantly greater gains in collaborative practice within the classroom than other teachers.

Overall, these findings show **that the MaST Programme has had a highly significant impact on the collaborative practice of teachers**, as well as their confidence and self-efficacy.

6. Value for Money

Key findings

- The total cost of the MaST Programme for Cohort 1 and 2 is estimated at £21.2m. The HEI costs accounted for just over half (52 per cent) of this amount.
- Our assessment of programme efficiency suggests that **costs incurred in delivering the MaST Programme, on a per teacher, per school and per pupil basis were positive** when benchmarked against the most comparable programme for which we have data (i.e. the Every Child Counts evaluation).
- In analysing NPD data on Key Stage 1 and Key Stage 2 results, we sought to identify longer term additional outcomes which might have resulted from the overall programme objectives having been achieved. Our analysis found **no evidence of improved attainment at this stage. This is in line with the findings from the Every Child Counts evaluation.**

6.1 Introduction

This chapter presents the findings from the value for money analysis of the MaST Programme and is structured as follows:

- programme costs – a description of the delivery costs for Cohort 1 and 2 of the MaST Programme
- approach to evaluating value for money – a summary of the approach we have taken in assessing value for money
- assessment of value for money – a review of the economy and efficiency of the MaST Programme.

6.2 Programme costs

Table 6.1 below sets out the programme delivery costs for Cohort 1 and Cohort 2 teachers on the MaST Programme between 2009/10 and 2012/13 financial years¹³,

¹³ Cohort 2 will finish the MaST Programme in September 2012

split between variable programme costs and fixed programme overheads. The total cost of the programme for Cohort 1 and 2 is estimated at £21.2m¹⁴.

The HEI costs are associated with the management, design and delivery of the MaST courses themselves and are also linked to their anticipated throughput of teachers on the programme. This accounts for just over half (52 per cent) of programme spend covering Cohort 1 and Cohort 2. The overall HEI costs vary between years, reflecting the fact that at different time points they either had one or two cohorts of teachers on the programme.

In 2010/11 local provision costs (to develop locally tailored support for teachers and schools participating in the programme) and school cover costs (supply cover for teachers engaging in MaST CPD activities) were included in local authorities' Standards Fund Allocation, from which they were then distributed to participating schools. Since 2011/12, local provision costs have been paid directly to the HEIs, with school cover costs still being paid via local authorities. Cohort 1 participants in the MaST Programme also received a £3,000 incentive payment (paid in two instalments) if they completed the programme¹⁵ and this accounts for just over one-fifth (22 per cent) of the collective programme spend for Cohort 1 and 2.

Fixed programme overheads (i.e. those not related directly to the scale of delivery) included the initial management of the programme by National Strategies, as well as the evaluation programme; combined, these accounted for just over five per cent of the programme spend for Cohort 1 and 2.

¹⁴ 2012/2013 delivery costs are forecast figures.

¹⁵ The incentive payment was only made to Cohort 1 participants

Table 6.1 Total programme delivery costs for Cohort 1 and 2 MaSTs

Item	09/10	10/11	11/12	12/13 ¹⁶	Total
Variable programme costs					
HEI costs	£1,938,049	£4,394,866	£3,450,309	£1,202,954	£10,986,178
Local provision and school cover costs (pre-2011)	n/a	£2,573,460	n/a	n/a	£2,573,460
Local provision (post-2011)	n/a	n/a	£765,335	£118,210	£883,545
School cover costs (post - 2011)	n/a	n/a	£933,600	£170,880	£1,104,480
Incentive payments to Cohort 1 and Pathfinder teachers	n/a	n/a	£1,678,050	£2,938,000	£4,616,050
Fixed programme overheads					
Evaluation costs	£104,643	£40,675	£133,278	£118,280	£396,876
National Strategies Management Costs	£209,691	£462,700	n/a	n/a	£672,391
Total	£2,252,383	£7,471,701	£6,960,572	£4,548,324	£21,232,980

Source: DfE

6.3 Approach to assessing value for money

There are a number of ways in which the assessment of value for money (VFM) can be approached, but in essence, assessing value for money is about comparing intervention costs with the benefits to recipients, as well as considering the extent to which the intervention's objectives were met and whether the activities were delivered at minimum cost. Our approach to measuring the cost-effectiveness of the programme is to consider economy, efficiency and effectiveness as set out in Figure 6.1.

¹⁶ 2012/2013 are forecast delivery costs

Figure 6.2 Cost effectiveness measures

Economy¹⁷ (spending less) – economy considers the extent to which activities were delivered at minimum cost, so requires consideration of a ratios between activities and inputs

Efficiency (spending well) – efficiency considers the benefits or outcomes compared to the intervention cost (expressed in the form of a cost-benefit or cost-effectiveness ratios), including comparing additional outputs with the inputs used to achieve them (e.g. cost per additional pupil benefiting from the programme, or cost per additional teacher)

Effectiveness (spending wisely) – involves considering whether an intervention’s objectives have been met. This normally requires a judgement on the extent to which the achieved outcomes means that objectives have been met. In some cases it may also be appropriate to consider achieved outputs against targets.

Measuring effectiveness normally requires a judgement on the extent to which the achieved outcomes indicate the objectives have been met. This is complex in the case of the MaST Programme because the original objectives for the programme were qualitative ones and so it is not possible to compare achievements against quantitative targets (or to quantify them). Moreover, the data informing any judgements on the effectiveness of the programme (i.e. the extent to which the programme objectives have been met) has already been presented in earlier chapters of the report, and will be revisited in the concluding chapter. For this reason, our analysis focuses on the economy and efficiency of the programme.

Central to the assessment of value for money is the definition and measurement of costs, inputs, outputs, outcomes and impact. From this it is possible to develop various ratios that can describe value for money, and ideally use benchmark data from other interventions to demonstrate how well the programme compares with similar interventions. Table 6.2 below describes the measures we have selected in undertaking the value for money assessment, as well as the evaluation evidence and secondary and administrative data that has informed them. Value for money ratios should also be considered in the context of wider qualitative data gathered through the evaluation.

¹⁷ Economy, efficiency and effectiveness are the ‘3Es’ set out in the National Audit Office framework for assessing value for money

Table 6.2 Measures used in determining VFM

Measure	Data source	VFM measure (and assumptions)
Programme inputs Total costs of programme	Department for Education All data is incurred expenditure except for HEI, local provision and supply costs for Q2 of 2012/2013 which is projected spend	Economy and efficiency Disaggregated to include all variable and fixed costs related to delivery of Cohort 1 and Cohort 2 of the MaST Programme (including all management and evaluation)
Programme activity Number of schools supported through Cohort 1 and 2 of the MaST Programme	HEI data on teachers recruited to MaST Programme Derived from matching data on MaSTs recruited to NFER's Register of Schools database	Economy and efficiency Total lifetime programme costs per MaST school supported
Programme outputs Actual numbers of MaSTs completing the programme (Cohort 1 and Cohort 2)	Department for Education and HEI returns	Economy and efficiency Total lifetime costs per contracted teacher HEI costs per MaST teacher enrolled (Cohort 1 and 2)
Programme outputs Estimated number of pupils benefiting from the programme	HEI data on teachers recruited to MaST Programme Derived from matching MaSTs to their schools in the Register of Schools database, and deriving average schools size (including all year groups except nursery classes)	Efficiency Total costs per pupil potentially targeted by the programme.
Programme outcomes Number of participating teachers reporting benefits to teaching and learning: <ul style="list-style-type: none"> • deeper knowledge and understanding of mathematics at Key Stage 1 and Key Stage 2 • increased MaST participation in professional development of colleagues 	NFER Teacher surveys	Efficiency and effectiveness Extent to which programme has achieved its desired outcomes for teachers' subject knowledge , capacity and skills
Short term programme impact Improved pupil attainment in mathematics in participating schools in lessons delivered by MaSTs (compared with those in non-participating schools) - % point increase in attainment in participating schools	NPD matched data analysis	Efficiency and effectiveness Extent to which programme investment has generated improved numeracy skills amongst pupils as a result of CPD <ul style="list-style-type: none"> • cost per pupil improving attainments • cost per percentage point improvement

Table 6.3 describes the throughput data related to teachers' participation in the MaST Programme, and the associated number of schools and pupils that have benefited from their participation. The data have been used in deriving the economy and efficiency ratios that are reported in the remainder of this chapter.

Table 6.3 Description of throughput variables used in the VFM analysis

Throughput variable	Number	How data has been derived
Schools participating in MaST Programme	<ul style="list-style-type: none"> • Cohort 1 – 1,190 schools • Cohort 2 - 1,121 schools • Unique schools across two cohorts – 2,281¹⁸ 	<p>Data is based on HEI data supplied at the start of the evaluation related to teachers that had been recruited to Cohort 1 and Cohort 2 of the programme, from which it was possible to establish the number of schools that have benefited.</p> <p>As we are unable to disaggregate financial data for Cohort 1 and Cohort 2 we have based calculations on the number of 'unique' schools to avoid double counting of schools.</p>
Teachers participating in the MaST Programme	<ul style="list-style-type: none"> • Cohort 1 and 2 (target) – 3,510 teachers • Cohort 1 and 2 (recruited) – 2,820 teachers • Cohort 1 and 2 (completed)¹⁹ – 2,205 	The data has been supplied by DfE via the participating HEIs.
Number of pupils benefiting from the programme	<ul style="list-style-type: none"> • Cohort 1 – 315,530 pupils (average 265 per school) • Cohort 2 – 302,207 pupils (average 277 per school) • Total Cohort 1 and 2: 617,737 pupils 	This data has been derived by establishing the average size of schools (excluding nursery classes) in each of the cohorts and multiplying this by the number of participating schools in each cohort. It should be noted that where a school is included in Cohort 1 and Cohort 2 we have not included the pupil numbers in the Cohort 2 calculations to avoid double counting of pupil numbers.

Source: Data obtained through HEIs and DfE

Financial data on programme delivery costs was provided in aggregate form covering both Cohort 1 and Cohort 2 of the MaST Programme over the last four years. We were therefore unable to make comparisons between the two cohorts with respect to overall value for money. Furthermore, evaluation evidence on achieved outcomes is cohort specific. For example, attainment data is linked to

¹⁸ Where a school has a teacher participating in both Cohort 1 and 2, we have only counted the schools once, in order to avoid double counting. 30 schools were involved in both cohorts.

¹⁹ This includes anticipated completers for Cohort 2 based on HEI returns for April 2012 (these teachers will complete the MaST Programme in September 2012)

pupils in schools with a Cohort 1 MaST²⁰, and teacher/pupil survey data is linked to schools with a Cohort 2²¹ MaST. In these circumstances, our overall approach has been to assume that any outcomes achieved in relation to either cohort were likely to have been replicated in the other, and therefore financial, output and outcome data have been aggregated across the two cohorts for the purpose of the value for money analysis.

6.4 Identifying appropriate benchmarking data

As well as deriving VFM measures for the MaST Programme it is useful to benchmark these against similar programmes. We identified the Every Child Counts (ECC) as the only suitable intervention against which the MaST Programme could be benchmarked for the purposes of the value for money assessment, due to the lack of comparable analysis and evaluation evidence on other programmes. The Every Child Counts intervention was introduced in 2007, with a commitment to provide support to 30,000 six year old pupils (focused on the lowest achieving 5 per cent of Key Stage 1 children) by 2010/11.

The key ECC programme was Numbers Count (NC) which provided one-to-one and very small group support to pupils through a specialist trained Teaching Assistant. The aim was to raise the performance of the lowest achieving children so that they were on par with their peers by the end of Key Stage 1. Numbers Count consisted of a 12 week programme, with daily 30 minute sessions for the target children. The programme provided funding to help schools employ and train specialist Numbers Count Teachers (NCTs).

The MaST Programme aimed to build additional mathematics capacity across the primary school system to improve the quality of mathematics teaching and learning. Thus the overall approach was intended to benefit a wider group of pupils in schools, than the ECC intervention which targeted pupils most in need of support around numeracy. In practice, however, a longer term outcome of the MaST Programme could be improved attainment in mathematics if the objective of improved teaching was achieved. With this in mind, the ECC programme was identified as a potential source of benchmark data on aspects of value for money. We therefore reviewed the methodology that was adopted in evaluating the ECC intervention, to assess the

²⁰ This reflects the fact that Cohort 1 schools will have had a MaST for longer and as such there was a longer period over which impact on attainment could have occurred

²¹ Cohort 1 had already started the MaST Programme at the time of the evaluation was commissioned and therefore it was not possible to establish a 'baseline' position for this group.

suitability and applicability of using data from that programme as a benchmark for the MaST Programme²².

The ECC evaluation used a measure called Incremental Cost Effectiveness Ratio (ICER) which compares the costs and impact for the ECC programme and normal classroom teaching, or the reference case. The primary outcome measure was the achievement of a raw score measure which was converted to National Curriculum levels.

It is important to note, however, that the overall design of the two programme evaluations was different. The ECC programme adopted a randomised control trial (RCT) design which allowed for 'net impact' measures to be gathered taking into account changes in attainment amongst the control group. In contrast, the approach taken for the MaST Programme was to first undertake propensity score matching, which removed any pupils/schools with characteristics that either only appear in the MaST group or only appear in the comparison group. Multi-level modelling was then undertaken to compare pupils in **Cohort 1** MaST schools and other non-MaST schools for both 2009 and 2011 results testing for any significant differences between these groups of schools in terms of rate of progress made between the two time points, based on the following outcomes:

- Key Stage 1 Mathematics teacher assessments
- Key Stage 2 Mathematics test results.

Despite the differences in approach taken by the two programmes, the MaST evaluation approach has allowed for a loose replication of the economic aspects of the ECC evaluation, enabling us to:

- compare the total running costs for the programme (and by school, teacher and pupil)
- compare the 'additional' proportions of pupils who achieve the expected level for Key Stage 1 and Key Stage 2, relative to comparison schools and pupils.

6.5 Assessment of value for money

6.5.1 Economy

In examining the economy of the MaST Programme (i.e. the extent to which activities were delivered at minimum cost), we have calculated the average costs of different elements of the programme. The ratios have been derived from the financial data provided in Table 6.1 and the throughput data described in Table 6.3. The HEI

²² Every Child Counts: the independent evaluation executive summary, Torgerson, C.J. et al (March 2011) DFE-RBX-10-07

programme costs amount to £4,816 per school that had a teacher participating in Cohort 1 and 2 of the MaST Programme. The HEI cost per teacher completing (or anticipated to complete) the MaST Programme is £4,892. As can be seen in Table 6.4, the HEI cost per teacher would have been just over 20 per cent lower (£3,896) had all the teachers recruited to Cohort 1 and 2 gone on to complete the programme.

Local provision and school cover costs amounted to £1,991 per school that had a teacher participating in Cohort 1 and 2 of the MaST Programme, with a figure of £2,060 per teacher completing (or anticipated to complete the MaST Programme). The anticipated annual payment to each school at the start of the programme was £480 per year to allow the MaST teacher to attend six half day workshops, and £80 per year to cover the teacher's time when the LA visited (cover costs). In addition, local authorities received an annual payment for £4,550 to support each group of 10 teachers they worked with (local provision costs).²³ This implies that supply and local provision costs were originally anticipated to be in the region of £1,095 per teacher/school per year or c. £2,190 per teacher completing the course based on average length of two years. Thus, the overall actual supply and local provision costs per teacher/school appear to have been slightly lower than was originally anticipated.

The incentive payments made to teachers in Cohort 1 of the programme amounted to £3,640 per teacher based on completers (and anticipated completers). By way of comparison, this is somewhat higher than the anticipated incentive payment which was intended to be £3,000 (of which £1,000 was paid on completion of the first year and £2,000 on completion of the full programme). This probably reflects the fact that some teachers will have dropped out of the course at some point after they had received the first payment at the end of year one and as such they are not counted as a completer, even though they did receive part of the incentive payment.

²³ From 2011 this was paid directly to the HEIs rather than the local authorities.

Table 6.4 Ratio of MaST delivery costs for Cohort 1 and 2 (2009-2012)

Description of delivery cost	Costs (input)	Ratio of MaST delivery costs
HEI costs	£10,986,178	£4,816 per school £4,982 per teacher for Cohort 1 and 2 (completers) £3,896 per teacher for Cohort 1 and 2 (recruited)
Local provision and school cover costs	£4,541,485	£1,991 per school £2,060 per teacher for Cohort 1 and 2 (completers) £1,610 per teacher for Cohort 1 and 2 (recruited)
National Strategies Management costs	£672,391	£295 per school £305 per teacher for Cohort 1 and 2 (completers) £238 per teacher for Cohort 1 and 2 (recruited)
Incentive payments to cohort 1 and Pathfinder teachers	£4,616,050	£2,024 per school (Cohort 1) £3,640 per teacher – completers (Cohort 1)
Total programme costs (excluding evaluation)	£20,836,104	

Source: Data obtained through HEIs and DfE

6.4.2 Efficiency

Efficiency, considers the benefits or outcomes compared to the intervention costs (expressed in the form of cost-benefit or cost-effectiveness ratios), including comparing additional outcomes with the inputs used to achieve them. Below, we consider programme costs in relation to achieved outputs and outcomes, specifically:

- cost per pupil, teacher and school supported by the MaST Programme
- impact on attainment of pupils at Key Stage 1 (based on teacher assessment) and Key Stage 2 (based on test results)
- extent to which the strategy generated specific (additional) benefits, given the programme inputs.

Cost per school, teacher and pupils supported by the MaST Programme

In developing efficiency ratios based on overall programme costs we have removed two expenditure lines from the equations. These are: *incentive costs* (on the basis they were applicable to Cohort 1 only as part of establishing the programme) and *evaluation costs* (which sit outside the overall programme delivery costs). On this basis we have defined programme delivery costs for Cohort 1 and 2 as £16,220,054.

The lifetime programme cost (Cohort 1 and 2) for each school that has one or more MaSTs was **£7,111 per school** (or c.£3,550 per year based average length of course of two years). The overall cost would appear efficient when compared to the total average schools costs of the Every Child Counts programme, which were £59,586 per school over a four year period (or c.£14,897 per year). In other words, the cost of running the MaST Programme per school and per year, was approximately a quarter that of the ECC programme. Furthermore, the MaST model of cascading knowledge within schools meant the programme was intended to benefit all children, rather than a specific group of children (as was the case for the ECC programme).

The lifetime programme costs (Cohort 1 and 2) for teachers completing the MaST Programme was **£7,356 per teacher** (or c.£3,678 per year based on average length of a two year MaST course). This compares with £13,589 per annum for a 50 per cent FTE teacher delivering Numbers Count on a one-to-one basis, as part of the Every Child Counts programme. For reasons already highlighted, the two programmes are not directly comparable given the differences in delivery model, but on the basis of the data we have it would appear that the MaST Programme has been delivered with efficiency in the context of per teacher costs.

In the endpoint Headteacher survey we asked if they would recommend to another Headteacher that they should pay for one of their staff members to receive the MaST training: 85 per cent indicated they would. They were then asked how much they would expect to pay for each year of a two programme. Nearly three-quarters (73 per cent) indicated they would expect to pay £1,000 or less, and 15 per cent would expect to pay between £2,000 and £3,000. Whilst overall this is significantly lower than average cost per year we have calculated for Cohort 1 and 2 (c. £3,678), it does suggest that Headteachers value the programme and would be willing to make a contribution towards a member of staff participating in it.

The lifetime programme cost (Cohort 1 and 2) for each pupil in schools with a MaST is estimated at **£26 per pupil**. These estimates indicate that the programme has been cost efficient when compared with the Every Child Count Programme which was estimated to have cost an average of £1,353 per child (where children were taught on a one-to-one basis). That said, the two programmes are not directly

comparable given the ECC programme was based on a support model working with small numbers of pupils, whereas MaST was intended to benefit all children in schools with a participating teacher.

It should be noted that the cost efficiency ratios described above do not take into account any supply costs that might have been incurred in releasing MaSTs to allow them time to support and deliver relevant professional development activities to colleagues within their school. If this time were to be included overall costs could increase²⁴. We know, for example, from the most recent MaST endpoint survey that just under half (49 per cent) of respondents were spending between a half and one full day per term working collaboratively with colleagues on mathematics development, with almost a quarter (23 per cent) spending more than 2 days per term on this type of collaborative activity.²⁵

Impact on attainment at Key Stage 1 and Key Stage 2

The aim of our statistical analysis of Key Stage 1 and Key Stage 2 data was to compare the results of pupils in schools with a MaST against the performance of pupils in other schools, between 2009 and 2011. A detailed description of the approach taken to this multi-level modelling can be found in the Technical Appendix. The key findings of the statistical analysis on attainment data was as follows:

- for **Key Stage 1** mathematics there was no significant difference between MaST schools and other schools in 2009. Additionally the rate of change in results between 2009-2011 was not statistically significant. At the 95 per cent confidence interval the impact of the programme was that schools with a MaST teacher in the relevant year groups made between 0.35 points²⁶ more progress and 0.15 points less progress than comparison schools between 2009-2011.
- for **Key Stage 2** mathematics there was also no significant difference between MaST and other schools in 2009, and again the difference in the rate of change in results between 2009 and 2011 was not significant. At the 95 per cent confidence level for the impact of the programme that schools with a

²⁴Cohort 1 MaST schools did receive £480 each to provide cover so teachers could undertake professional development activity in school for one day per term. This covered period from Jan-Sep 2010 only.

²⁵ 28% of survey respondents did not answer this question

²⁶ This would be the equivalent of 6 per cent of pupils achieving one level higher than they would have done without the impact of the MaST Programme.

MaST in the relevant year groups made between 0.15 points²⁷ more progress and 0.2 points less progress than comparison schools between 2009-2011.

The statistical analysis found **no robust evidence of the programme having had an impact on Key Stage 1 or Key Stage 2 results**. Whilst, it remains plausible that the programme may have had a small positive impact on pupils, **we cannot develop any efficiency ratios based in improved attainment by pupils at Key Stage 1 or Key Stage 2** based on the evidence we have.

The finding of no significant positive impact on Key Stage 1 and Key Stage 2 results as a result of the programme is broadly in line with similar analysis of Every Child Counts. The ECC evaluation found evidence that children receiving the intervention achieved higher average (mean) scores in the GL Education Group assessment progress in Mathematics 6 (PIM 6) test compared with an equivalent group of children that did not receive the intervention (equivalent to seven weeks' improvement for children that were part of the programme). Despite this, analysis of NPD Key Stage 1 scores to assess the short and medium term impact for Every Child Counts on schools, failed to reveal any significant impact, as was the case for the MaST Programme²⁸.

Evidence of the MaST Programme generating specific additional benefits

The evaluation included a survey of teachers participating in Cohort 2 of the MaST Programme, as well as of pupils in schools with the Cohort 2 MaST teacher. In both cases a baseline survey was undertaken, which was followed by an endpoint survey, allowing us to track changes in attitudes and perceptions over time²⁹. These surveys were also replicated in comparison group schools (with teachers and pupils), allowing responses to be compared between these schools and MaST schools.

In analysing the survey data we sought to identify additional outcomes or benefits that might have been generated through participation in the MaST Programme that can inform our assessment of overall efficiency. Specifically, we have reviewed evidence on teachers' perceptions of their own confidence in teaching mathematics at Key Stage 1 and Key Stage 2, and in being able to support the professional development of their peers. We have also analysed pupil responses with respect to their enjoyment, confidence and ability in mathematics.

²⁷ This would be the equivalent of 2.5 per cent of pupils achieving one level higher than they would have done without the impact of the MaST Programme

²⁸ Every Child Counts: the independent evaluation executive summary, Torgerson, C.J. et al (March 2011) DFE-RBX-10-07

²⁹ The baseline teacher survey was conducted in early 2011, with a mid-point survey in late 2011, and an endpoint survey in June-July 2012. The pupil baseline survey was conducted in September-November 2011 with an endpoint survey in June – July 2012

Table 6.5 below highlights the relevant survey results for baseline and endpoint surveys for MaSTs and pupils in schools with a MaST, as well as the comparison group teachers and pupils.

Teacher confidence in knowledge of mathematics at Key Stage 1 and Key Stage 2, appears to have increased amongst the MaSTs between the baseline and endpoint surveys, from 24 per cent to 41 per cent at Key Stage 1 and from 42 per cent to 73 per cent at Key Stage 2 reporting they were *very confident*. Similarly, MaSTs' confidence in mentoring/coaching colleagues on mathematics teaching has also grown from 9 per cent to 37 per cent reporting they were *very confident*. This could suggest positive additional benefits from the programme with respect to confidence in subject knowledge. As individual staff were not tracked between the baseline and the endpoint surveys, and so the samples at the two time points were not identical, it has not been possible to test the significance of these particular findings. However, these findings are supported by the multiple regression analysis reported in Section 5.7 which found a significant positive impact attributable to participation in the MaST Programme on participating teachers' confidence in teaching mathematics and their beliefs about their own effectiveness, often described as self-efficacy.

The difference in MaSTs' responses between the baseline and endpoint surveys suggests they are now undertaking professional development activities with colleagues more frequently. At the time of the baseline survey, 12 per cent of MaSTs reported offering advice to colleagues on mathematics-specific pedagogies half termly or more, and this grew to 45 per cent of MaSTs responding to the endpoint survey. Similarly, there was an increase from 5 per cent to 26 per cent in MaSTs reporting they led meetings or discussions with colleagues to review and support their mathematical knowledge at least once every half term. Again, these findings are supported by the multiple regression analysis reported in Section 5.7 which shows that the MaST Programme had a highly significant impact on the collaborative practice of teachers, as well as their confidence and self-efficacy.

Analysis was undertaken to seek out significant differences between those pupils taught by MaSTs and those in the comparison schools at the endpoint of the evaluation. In many cases, differences between the MaST and comparison samples proved slight and not statistically significant. However, the findings revealed that significantly more Key Stage 2 pupils in MaST schools reported finding mathematics interesting and wanted to pursue a job in mathematics when they grew up. The pupil questionnaire at Key Stage 2 therefore yielded some suggestion that children's views on enjoyment of mathematics backed up those of their teachers. However, given the limited evidence on an increase in pupils' perceptions of their enjoyment, confidence and abilities in mathematics, we have not sought to monetise any

changes. We are therefore, unable to comment on efficiency with respect to the achievement of additional benefits arising from the programme

Table 6.5 Extent to which the MaST Programme has generated additional outcomes³⁰

Outcome	Baseline survey	Endpoint Survey
Teachers' confidence:		
Teachers' confidence in their own knowledge of mathematics at Key Stage 1 (<i>very confident</i> responses)	MaST = 24% Comparison = 41%	MaST = 41% Comparison = 43%
Teachers' confidence in their own knowledge of mathematics at Key Stage 2 (<i>very confident</i> responses)	MaST = 42% Comparison = 61%	MaST = 73% Comparison = 69%
Confidence in mentoring/coaching another member of staff on mathematics teaching (<i>very confident</i> responses)	MaST = 9% Comparison = 29%	MaST = 37% Comparison = 37%
Pupils' confidence, enjoyment and ability:		
Key Stage 1: 'I am good at mathematics' (ability) –yes responses	MaST = 64% Comparison = 61%	MaST = 59% Comparison = 56%
Key Stage 1: 'Mathematics is easy' (confidence) –yes responses	MaST = 49% Comparison = 51%	MaST = 41% Comparison = 40%
Key Stage 1: 'I like mathematics' (enjoyment) – yes responses	MaST = 65% Comparison = 68%	MaST = 64% Comparison = 64%
Key Stage 2: 'I do well in mathematics lessons (ability) – <i>all the time</i> responses	MaST = 21% Comparison = 22%	MaST = 25% Comparison = 24%
Key Stage 2: 'I find mathematics easy' (confidence) – <i>all the time</i> responses	MaST = 14% Comparison = 15%	MaST = 15% Comparison = 13%
Key Stage 2: 'I like the way we learn things in mathematics' (enjoyment) – <i>all the time</i> responses	MaST = 52% Comparison = 49%	MaST = 46% Comparison = 41%
Frequency of MaST professional development activity with colleagues		
Offering advice to colleagues on mathematics-specific pedagogies (half termly or more)	MaST = 12% Comparison = 24%	MaST = 45% Comparison = 28%
Leading meetings or discussion with colleagues to review and support their mathematical subject knowledge (half termly or more)	MaST = 5% Comparison = 12%	MaST = 26% Comparison = 22%

Source: NFER Pupil and Teacher Survey

³⁰ It is important to note that comparisons between the two time points must be made with caution, as individual pupils were not tracked between the two surveys, so the samples at the two time points are not identical. It is also possible that the comparison schools may have underlying factors which make them different from the MaST schools. For example, the comparison schools may have been engaged in other school improvement activities which may have affected respondents' answers to the survey.

6.6 Conclusions

In analysing NPD data on Key Stage 1 and Key Stage 2 results, we sought to identify longer term additional outcomes which might have resulted from the overall programme objectives having been achieved. Our analysis found no evidence of improved attainment at this stage, but as already discussed, this is in line with the findings from the earlier Every Child Counts evaluation.

Our assessment of programme efficiency suggests that costs incurred in delivering the MaST Programme, on a per teacher, per school and per pupil basis were positive when benchmarked against the most comparable programme for which we have data (i.e. the Every Child Counts evaluation). It is important to note, however, that the focus of the interventions was different. Whilst ECC was targeted on a specific group of children requiring support in mathematics, the MaST Programme sought to improve teacher confidence and skills in mathematics, through a model in which they shared their new skills with colleagues. In this respect the MaST Programme had the potential to benefit a wider group of pupils.

In light of the dearth of suitable benchmarking data on the costs of delivering such programmes, the cost ratios that have been calculated for this evaluation will add to the evidence base for future research in related fields.

7. Sustainability and legacy of the support being provided to Cohort 1 and 2 MaSTs

Key findings

- There is **no nationally coordinated sustainability strategy for the MaST Programme** and it is being left to local authorities to allocate resources and put in place structures to support the continued development of MaSTs and to capitalise on the opportunity to draw on their skills and expertise to support other schools. This fits with the emerging education landscape of delegated powers, increased autonomy and delegated leadership.
- There are **encouraging signs that a number of local authorities are putting in place structures to support MaSTs to continue their development** and are drawing on MaSTs' learning and skills to improve mathematics teaching within their area. They understand the key role that MaSTs can play in the new landscape. However, it is a mixed picture and, in some local authority areas, no such support is being provided.
- Some **HEIs are playing a role in supporting MaSTs to continue to network and to keep up-to-date** and some groups of MaSTs are continuing to network of their own volition.
- **A small number of individual schools and groupings of schools (e.g. clusters, federations, Teaching Schools) are starting to draw on the expertise of MaSTs to improve mathematics teaching** and learning within their neighbouring/linked schools.
- **A small proportion of MaSTs (around 10-20%) are continuing their Masters study.**

This chapter explores the sustainability and legacy of the MaST Programme in relation to the support being provided to Cohort 1 and 2 MaSTs to continue to develop their mathematics expertise and the extent to which MaSTs are starting to undertake mathematics-related activities *with other schools* in their local area. Chapter 5 has explored MaSTs' plans for the future development of their work *within their own school*.

This chapter explores:

- continuing support for MaSTs to network and exchange learning and good practice to enable them to sustain their professional development activities
- the roles that MaSTs are being encouraged and supported to play within their local authority
- professional development delivered by MaSTs that is starting to be initiated by individual and groupings of schools (e.g. clusters, federations, Teaching Schools)
- opportunities for MaSTs to continue further academic study.

It also notes the wider influence that the MaST Programme is having on subject-specific CPD.

7.1 Continuation of support for professional development

There are encouraging signs that there is some continuation of support for MaSTs to further develop their mathematical expertise and their use of pedagogies. However, this varies by local authority area and, in many cases, relates to whether the local authority in which they are based has retained its primary mathematics consultants. Where primary mathematics consultants are still in post, local authorities are, in the main, committed to ensuring the ongoing development of qualified MaSTs and their role in supporting other schools, as this local authority consultant emphasises:

Mathematics is championed in [name of local authority] by senior staff and they will ensure that this programme continues to have impact.

Where they are still in post and there is sufficient capacity, **local authority mathematics consultants are already supporting, or plan to support, the ongoing professional development of Cohort 1 and 2 MaSTs.** For example, one local authority has already set up an 'After MaST' group for Cohort 1 MaSTs who continue to meet termly to reflect on their experiences and apply the knowledge they gained through the MaST Programme. Similarly, another local authority has set up a 'Beyond MaST' group for Cohort 1 and 2 MaST completers, which is being run in collaboration with the link HEI. MaSTs will meet on a termly basis and will be involved in a variety of activities both within their schools and other schools. In addition, in most cases, MaSTs who are also mathematics subject leader/coordinators will continue to access professional development as part of this role where it continues to be facilitated by their local authority, or, if they are not already part of this group, will join it in their capacity as a qualified MaST. One local authority consultant reported that the authority's approach to continuing professional

development was increasingly focusing on subject leaders whose role was to cascade learning to other teachers in the school in the way that MaSTs have been doing. As this consultant commented:

It's not someone from the local authority, or the DfE, telling the school what to do. It's about someone is on the ground working with the children and they make the change happen. And because they are responsible for making these changes, the staff in the school also make the change happen. Because it's coming from them, it's more secure.

One local authority is paying supply cover for small schools to send their MaST to afternoon network meetings. However, funding may become an issue in relation to the continued running of local network meetings specifically targeted at qualified MaSTs.

In some local authorities, qualified MaSTs have become Senior Leaders in Education (SLEs), Leading Mathematics Teachers (LMTs) or Leading Teachers (LTs) and, as part of this role, they will continue to receive opportunities for professional development.

In one local authority, qualified MaSTs and Every Child Counts teachers will be brought together in termly meetings to support their professional development and to keep them up-to-date (e.g. on revised Ofsted inspection criteria and new research) and to prepare them to take an increasing role in the delivery of professional development for other teachers. This local authority will also run meetings for qualified MaSTs to strengthen school improvement strategies in respect of mathematics and will provide MaSTs with support via email and telephone.

Consultees have, though, reported that some local authorities no longer have the structures in place to support MaSTs in their ongoing professional development, or in using their expertise to support other schools, as this HEI consultee reports:

One of the biggest challenges is having a structure in place to make good use of these teachers once they have finished and where the local authority structure has gone, but certainly where funding is so much tighter, organising ongoing developments and projects where a MaST teacher may work with a network of schools is really difficult.

(HEI consultee)

As well local authorities, some of the HEIs are devoting time and energy to supporting the continued development of Cohort 1 and 2 MaSTs. Two HEIs are

continuing to run meetings for MaSTs to support their ongoing networking. One of these HEIs is running mathematics networks for all mathematics leads/coordinators in their area and MaSTs are leading some of the sessions. These meetings are being facilitated by a local authority consultant who has recently been employed by the HEI. However, it is likely to be MaSTs who live in close proximity to the HEI facilitating the meetings that will attend these meetings due to travel time and cost. In some cases, HEI staff are attending networking sessions run by local authorities.

More commonly, HEIs have organised celebration events for MaSTs and their headteachers and have started to run annual MaST conferences. In addition, HEIs are keeping in touch with MaSTs through email, for example to alert them to new developments and research in relation to mathematics. One HEI consultee mentioned that they have set up a Facebook page to support MaSTs to keep in contact and others are using alumni for this purpose.

A number of HEIs have also seen an opportunity in terms of MaSTs supporting students on their PGCE courses and are linking MaSTs with students on school placements so that they can provide them with ongoing support. In some cases, HEIs are offering schools who take a PGCE student a reduction in fees for the MaST Programme to encourage schools to agree to teachers undertaking the programme. HEIs have also reported MaSTs supporting the delivery of PGCE or undergraduate courses by observing lessons or moderating student assignments.

In some areas where no ongoing support is being provided by local authorities or the HEI, **MaSTs have formed their own network and continue to meet to share learning and expertise**. For example, in one local authority area, Cohort 1 MaSTs meet once a month and have developed a structure to their meetings which mirrors that of local network meetings. One teacher brings a mathematics activity for them to engage with, another brings something from the classroom and another brings a research paper for them to discuss. As an HEI consultee commented: ‘...that ‘community of practice’ has been really important, working with like-minded people who are inspired by mathematics and who can support each other when the going gets tough...’.

Several consultees have also mentioned the work of NRIC which is an organisation which, alongside other activities, supports the professional development of primary mathematics specialists and secondary mathematics teachers. NRIC has organised networking opportunities for MaSTs at a reasonable price which have been reported to have been useful.

7.2 The roles that MaSTs are starting to play within their local authority

Just over a fifth (22 per cent) of surveyed Cohort 2 MaSTs reported that they had already worked with other schools to support their development and improvement of mathematics. Three-fifths (59 per cent) of teachers reported that they had not yet worked with other schools to support their development and improvement and a further 17 per cent reported that planned to do so, or that this was currently under development (See Table B.45 in Appendix B). Of these, MaSTs most commonly planned to provide direct support for teaching and to hold cluster meetings with colleagues in other schools (in 58 per cent, and 35 per cent of cases respectively). A further 8 per cent intended to undertake lesson observations. (See Table B.46 in Appendix B.).

MaSTs felt that **the most common challenge to working with colleagues in other schools was time**: just under a quarter of MaSTs (24 per cent) reported that this was the case. A further fifth (21 per cent) of MaSTs reported that there had been no opportunities to work with colleagues in this way as yet and 15 per cent were currently focusing on activities within their own school. (See Table B.47 in Appendix B.).

Where local authority staff are still in post, **MaSTs are being encouraged to play a role as a mathematics specialist within their local area**. They are already working, or will in the future work, in a variety of ways to support other schools. As mentioned above, some local authorities have designated MaSTs as Senior Leaders in Education (SLEs), Leading Mathematics Teachers (LMTs) or Leading Teachers/Professionals and, in these roles, they will be called upon to provide mathematics specific support in response to request from headteachers or to support newly qualified teachers (NQTs) or 'less effective' teachers. Other ways in which MaST are playing a role in supporting the development of mathematics in their local area include:

Developing/disseminating materials

- MaSTs being brought together to write materials and guidance for other schools
- MaSTs supporting the writing of the local authority's approach to mathematics and the preparation of a toolkit to support the effective teaching of mathematics
- MaSTs from Cohort 1 and 2 being brought together to develop good practice case studies that can be used to support non-MaST schools

- MaSTs working with schools to develop mathematics resources and schemes of work
- the sharing of MaSTs' assignments at local authority level.

Delivering professional developing/supporting schools

- local authorities setting up a register of MaSTs for headteachers to refer to when they require support or professional development on mathematics
- MaSTs attending conferences designed to facilitate MaSTs working with other schools or leading sessions at annual local authority conferences or workshops targeted at primary mathematics teachers within all schools
- MaSTs leading/coordinating local networks of mathematics teachers or subject leaders' clusters
- MaSTs running twilight sessions or other INSET sessions to share their expertise with subject leaders or deliver targeted professional development
- MaSTs running sessions as part of a Headteachers' Forum or inputting to partnership headteacher briefings
- MaSTs sharing experiences at local authority Curriculum Support Group meetings
- MaSTs being employed as, or seconded to work as, mathematics consultants or advisory teachers by local authorities to work with schools that have issues with mathematics teaching
- an example of a MaST being employed as a consultant to work with Cohort 1 and 2 qualified MaSTs to quality assure their teaching, liaise with headteachers and provide termly professional development opportunities around school improvement and teaching and learning strategies
- MaSTs supporting local authority in-house training and being integrated into the professional development delivery team
- MaSTs working with other schools to: develop their expertise in lesson study; model lessons for teachers in schools where mathematics is in need of improvement; and mentor and coach teachers
- qualified MaSTs mentoring MaSTs in Cohorts 3 and 4.

Some local authorities are seeing qualified MaSTs as key to the delivery of their primary mathematics professional development in the future, as these local consultants report:

I envisage this group eventually forming the backbone of teacher-teacher and subject leader-subject leader support across the county and we will involve Cohorts 3 and 4 when appropriate (Local authority consultant)

I expect most of the changes to practice to take place in the immediate years after the completion of the programme (Independent consultant).

Some **local authority consultees felt that no impacts, as yet, had been seen outside of the MaSTs' schools and commented** that some MaSTs (generally those less experienced in mathematics) needed to embed improvements in their own school before supporting teachers in other schools. Some headteachers echoed this reporting that, at this stage, they saw their MaSTs' work with other schools as a lower priority preferring the focus to be on embedding developments within their own school first. It was also commented that some MaSTs would need further training to work beyond their own school.

7.3 School-initiated professional development

Although this is currently of a small scale and in its early stages, individual schools and groupings of schools (e.g. clusters, collaborations, networks, Federations, Teaching Schools) are also using their MaSTs to support the development and improvement of mathematics teaching amongst their neighbouring/linked schools. As two consultees commented:

There is a growing recognition that the role of the MaST is vital as the LA have lost their consultants. Networks are growing and MaSTs are being used to support and work with other colleagues.

(Independent mathematics consultant)

MaST specialists are used in clusters of schools working together to provide quality CPD and support for teachers in clusters.

(Local authority consultant)

In Teaching Schools or schools where the headteacher is an executive headteacher of a number of schools, MaSTs working across a number of schools tends to be a more natural occurrence.

Examples of activities that MaSTs and their headteachers have initiated include: **MaSTs working together to run training sessions; the sharing and cascading**

of ideas and good practice; and the provision of support to individual teachers.

One consultee gave an example of a cluster of schools in the local authority which had used National College for School Leadership funding to support the developmental work of the MaSTs across the cluster. In one case, this had resulted in a substantial impact on non-MaST schools where a MaST was seconded for a day a week over four terms to work across a cluster of four schools. Another example given was of a MaST teacher running three sessions on imagery for nine primaries and one secondary school within the local authority which more than 100 staff, teachers and TAs attended. In addition, some individual MaSTs have undertaken outreach in one local school or have shared the MaST materials with teacher friends in their area and other areas. Examples of headteachers sharing the impacts of MaST at headteacher meetings have also been given.

7.4 Opportunities for further academic study

In relation to opportunities for MaSTs to continue their Masters, **the eight HEIs already offer Masters in Education and some offer, or are developing, more specialist mathematics modules within these Masters programmes or are offering, or developing, specific courses relating to mathematics** (e.g. Advanced Diploma/Masters in Specialist Mathematics Teaching and Postgraduate Certificate in Primary Mathematics Education). One HEI is considering developing a mathematics leadership course in conjunction with the National College for School Leadership.

HEIs have encouraged Cohort 1 and 2 MaSTs to continue onto further study and estimate that around 10-20% of MaSTs have, so far, taken up this opportunity.

7.5 Wider influence on subject-specific CPD

It is also worth mentioning that the MaST Programme has had wider influence in terms of the development of similar subject-specific professional development programmes. One of the HEIs is submitting a bid to run a Primary Mathematics Specialist PGCE which has been inspired by the HEI's delivery of the MaST Programme. Another is developing a similar course for primary English leads.

In addition, the Wellcome Trust, in conjunction with the network of Science Learning Centres led by the National Science Learning Centre, has developed a 24-day continuing professional development (CPD) programme, the PSS Programme, for primary science coordinators who do not have a science background. This has been designed to develop the confidence, subject knowledge, teaching expertise and

subject leadership skills of participating teachers and has a number of similarities to the MaST Programme.

8. Conclusions and recommendations

The final chapter of this report draws conclusions from this evaluation of the Mathematics Specialist Teacher Programme. The chapter then presents evidence from the surveys and case-study visits to schools to explore the extent to which the programme has met its three key objectives as set out earlier in Section 1.2. The report concludes by providing several recommendations for consideration by the Department for Education, for Higher Education Institutions, local authorities and other CPD providers and for schools who want to improve the quality of their mathematics teaching.

8.1 Conclusions

The Mathematics Specialist Teacher Programme has made a valuable contribution to enhancing participating teachers' subject knowledge, pedagogical skills and collaborative working skills, resulting in meaningful impacts at the whole-school level. There is empirical evidence to suggest that the MaST Programme model has been effective in fostering deeper and more secure subject knowledge in participating teachers. The combination of HEI sessions and local network meetings has provided an integrated and comprehensive training experience for teachers. The theoretical underpinnings delivered through the HEI sessions have complemented the focus of the local network meetings on teachers' assessments of their own skills and the practical application of learning in teachers' own classrooms. The evidence collected suggests that participating teachers have benefited immensely from the networking opportunities provided in both of these forums and from the cohesive and supportive networks that have developed at a local level.

Mathematics specialists have reported that the programme has positively impacted on many aspects of teaching and learning across their schools. In particular, MaSTs have reported that the programme has impacted on the priority given to improving the quality of mathematics teaching and learning, and to improving attainment and standards in mathematics. Although embedded from the start, year 2 of the programme appears to have involved a greater emphasis on working with colleagues, on mentoring and coaching, and on approaches to supporting colleagues, such as lesson study. As a result, there is evidence that the programme has developed the expertise of the mathematics specialist in working with colleagues and in providing effective professional development of colleagues.

The evidence for the impact of the programme on pupils is more mixed. In the view of the participating teachers, the MaST Programme has made a positive impact on pupils in terms of their enjoyment of and confidence in mathematics. This perception is only partly supported by the findings from the pupil surveys. There is a suggestion

that pupil enjoyment of mathematics at Key Stage 2 is now higher in MaST than comparison schools, but this is not conclusive, and there is some indication that pupil confidence levels are actually higher in comparison schools. In addition, almost three-quarters of MaSTs reported that their pupils' attainment has been better over the previous 12 months than expected, and this proportion has increased substantially since the baseline survey. However, the analysis of pupil attainment data suggested that this perception has not yet been borne out by national assessment results.

While there is no nationally coordinated sustainability strategy for the MaST Programme, MaSTs have reported a variety of plans for the continuing development of mathematics beyond the end of the MaST Programme, both within their own schools and in other schools. For example, commenting on their or their schools' plans for the future development of mathematics, MaSTs identified a number of ongoing priorities. These included continuing to further embed the learning from the MaST Programme, including the development of pupils' higher-order skills, such as reasoning, problem-solving and mathematical thinking. In addition, there is some evidence that a number of local authorities and HEIs are putting in place structures to support MaSTs to continue their development and are drawing on MaSTs' learning and skills to improve mathematics teaching within their local areas. However, it is a mixed picture and, in some local authority areas, no such support is being provided.

Key aspects of the Mathematics Specialist Teacher Programme are in step with current thinking and developments in education policy. For example, the MaST Programme's capacity building model resonates with the Government's aim of creating a school system which is more autonomous and effectively self-improving as outlined in the Schools White Paper (2010): 'We will make sure that schools are in control of their own improvement and make it easier for them to learn from one another' (p.74). The Schools White Paper (2010) acknowledges the need for more mathematics specialists in primary schools and outlines the Government's promise to 'encourage and support schools in developing this specialism' (p.45).

Aspects of the MaST Programme are also similar to the practices and characteristics of schools identified by Ofsted (2012) as being the very best at teaching mathematics. These schools 'sought continuously to develop teachers' expertise' (p.22) and had 'a systematic approach to raising the quality of teaching in mathematics across the school' (p.21). In addition, these schools: directly engaged pupils in mathematics to deepen their understanding; encouraged pupils to work collaboratively; and challenged pupils to think for themselves, for instance by suggesting how to tackle a new problem or comparing alternative approaches (p.23). They also shared good teaching practices through peer observation, discussion and

coaching (p.53); an approach also encouraged by the National Centre for Excellence in the Teaching of Mathematics³¹.

The development of a subject-specialist role within primary schools, promoted by the MaST Programme, also corresponds with the Primary Science Specialist (PSS) CPD programme³² currently being funded and operated by the Wellcome Trust and delivered at the Regional and National Science Learning Centres. The programme has a number of similarities to the MaST Programme including a shared focus on developing the confidence, subject knowledge, teaching expertise and subject leadership skills of participating teachers.

8.2 Extent to which the key objectives of the programme have been met

1. To what extent has the programme developed the mathematical subject knowledge of participating teachers so that they gain a deep knowledge of mathematics within the Early Years Foundation Stage (EYFS) and primary curriculum?

The MaST Programme appears to have made a considerable positive impact on participating teachers' subject knowledge and confidence to teach mathematics. For example, the survey evidence suggests that confidence amongst MaSTs in subject knowledge at Key Stage 1 and Key Stage 2 has increased, and in this respect the programme appears to have been effective against the original objective.

2. To what extent has the programme promoted good understanding of a fit-for-purpose pedagogy that enables participating teachers to draw on a wide repertoire of teaching approaches?

The research highlights considerable personal impacts on participating teachers' subject-specific pedagogy and practice. MaSTs' have positive perceptions of their own effectiveness in a number of specific areas of teaching, especially 'setting high expectations for pupils', 'using practical resources' and 'challenging more able pupils'. These perceptions have been supported by headteachers. The findings from the pupil surveys support the MaSTs' view that they now have a wider range of teaching approaches and materials. For five out of seven examples of variety in pedagogy and

³¹ The National Centre for Excellence in the Teaching of Mathematics: <https://www.ncetm.org.uk/>

³² The Wellcome Trust:

http://www.wellcome.ac.uk/stellent/groups/corporatesite/@msh_grants/documents/web_document/wtvm055013.pdf [13 October 2012]

resources, pupils of MaSTs have reported significantly more frequent use than comparison pupils. The evidence collected suggests the programme has been effective in promoting fit-for-purpose pedagogies and in equipping participating teachers with a wide range of teaching repertoires.

3. To what extent has the programme developed the expertise of the mathematics specialist in working with colleagues and in providing effective professional development of colleagues through classroom-based collaborative professional activity?

There are indications that participating teachers have become more confident, and have engaged more frequently, in collaborative activities with colleagues as a result of the programme. The survey evidence suggests that confidence amongst MaSTs to support colleagues with mathematics related professional development activity has grown over the course of the programme. Activities involving discussions, meetings, training and support to colleagues outside of the classroom have taken place more frequently than activities inside the classroom involving collaboration in the context of teaching lessons. The improvement is supported by the responses of the MaSTs' headteachers. The findings suggest the programme has been effective in developing the expertise of a wider group of teachers, and in increasing the frequency of such activity.

8.3 Recommendations

The report concludes by presenting the following recommendations for consideration by the Department for Education, for Higher Education Institutions, local authorities and other CPD providers and for schools who want to improve the quality of their mathematics teaching.

8.3.1 Recommendations for the Department for Education

- **The Department should endorse and promote the programme to primary schools as it moves to a market model beyond Cohort 4.** Overall, the study has found that the MaST Programme has made a considerable positive impact on participating teachers' subject knowledge and confidence to teach mathematics and has positively impacted on pupils' enjoyment of and confidence in mathematics. Although not conclusive, there is some evidence to suggest that the programme has also led to improvements in pupils' attainment. These are messages that should be promoted and celebrated at the national, regional and individual school level. Failure to endorse the programme beyond Cohort 4 risks jeopardising its future uptake and

continued impact as well as reducing the value and currency of Mathematics Specialist Teacher status to schools.

- **The Department should consider using the MaST Programme as a model for strengthening teaching and learning in other subject areas.** Overall, the evidence collected suggests that the programme has been a success. As such, it should be considered as a potential model for driving improvement in primary schools by developing primary teachers' knowledge and pedagogical skills in other subject areas, such as science. In addition, the MaST Programme shows that an intensive, systematic and nationally available subject specific CPD programme can be a particularly effective mechanism for improving standards of teaching across a school. The programme's focus on collaboration within and between schools could also be a model that is taken forward by the Teaching Schools Alliance, while those successful teachers could become Specialist Leaders of Education. Many of the key aspects of the programme, such as: the combination of HEI sessions and local network meetings led by a subject specialist; in-school classroom focused work; work alongside colleagues, including coaching and mentoring; and the self-supported study strand could be elements of programmes in other subject areas. Moreover, the initial period of funding has helped to pump-prime the programme ahead of what will hopefully become a successful market expansion; an approach that could be used with future subject-specific CPD programmes.
- **The Department should consider tracking the pupils in MaST schools to see if pupil attainment and progression improves over the longer term.** One limitation of the evaluation was that the period of time over which pupil attainment data was analysed was relatively short and it may take longer for impact to become apparent (e.g. as teachers consolidate their new skills and/or disseminate these more widely amongst colleagues, or if pupils perform consistently better in later Key Stage tests as a result of the earlier intervention). Many consultees interviewed as part of the evaluation reported that MaST-school pupils were better able to tackle mathematical problems in a range of contexts than they were prior to the MaSTs becoming involved in the programme. If true, it seems likely that their enhanced understanding and appreciation for mathematics is likely to lead to an improved aptitude for and fluency in mathematics in later life.

8.3.2 Recommendations for Higher Education Institutions, local authorities and other CPD providers

- **HEIs, local authorities and other CPD providers could strengthen their training and professional development offer to teachers by combining theoretical content with opportunities for teachers to apply their learning in a practical way.** They should also look for opportunities to help facilitate local level discussions and support. Many consultees reported that the focus of local network meetings' on teachers' assessments of their own skills and the practical application of learning in teachers' own classrooms had complemented the theoretical underpinnings delivered through the HEI sessions. In addition, many MaSTs described the local network meetings as the best element of the programme due to them allowing MaSTs to discuss practice, share ideas and issues and ask questions in small, local, close-knit groups in which they all learnt from each other. The local network meetings clearly added value and were a key mechanism for the success of the programme. HEIs, local authorities and other CPD providers should continue to offer this type of activity and engage individuals with deep subject-specific and pedagogical knowledge and understanding of school contexts to facilitate them.
- **HEIs, local authorities and other CPD providers should continue to target and involve senior school leaders from the outset when promoting intensive and ongoing training and professional development activities to teachers.** The commitment of a school's senior leadership team was considered to be an essential component of successful engagement in the programme. Most HEIs recognised the importance of senior staff buy-in. However, some appeared slower than others in developing an engagement strategy for them, but found that once in place, this helped with recruitment and the smooth running of the programme.
- **In partnership with local authorities and schools, HEIs should consider putting in place arrangements to support MaSTs when they complete the programme. While there is some evidence that a number of local authorities and HEIs are putting in place structures to support MaSTs to continue their development and are drawing on MaSTs' learning and skills to improve mathematics teaching within their local area, it is a mixed picture and, in some local areas, no such support is being provided.** The potential benefits of following up with MaSTs are considerable, and include: reinforcement of learning; consolidating links with local authority

staff/consultants; sharing experiences with current cohorts; strengthening relationships with and between schools; collecting evidence of impact over the longer term; facilitating and sustaining teachers to become reflective practitioners; and encouraging teachers to pursue further study options.

8.3.3 Recommendations for schools

- **Schools should encourage their mathematics specialists to continue to develop support networks at a local and regional level.** The evidence collected suggests that participating teachers have benefited immensely from the networking opportunities provided by both the HEI and local network meetings and from the cohesive and supportive networks that have developed at a local level.
- **Subject specialists with deep subject and pedagogical knowledge need to be given the support and authority to lead and influence teaching and learning in order to effect whole school change.** A key factor for success in relation to a MaST's role in impacting on standards of mathematics teaching across the school has been the seniority of the MaST, and, linked to this, the MaST's confidence in undertaking CPD with staff across the school. The MaST Programme shows that mathematics subject specialists provided with the authority by senior leaders to influence practice in primary schools can be effective in championing mathematics and in promoting best pedagogical practice, both within their school, and within other schools.
- **Schools should promote a positive culture of continuous professional development which continually deepens the subject and pedagogical knowledge of staff.** The Williams Review (2008) posited that confidence and dexterity in the classroom are essential prerequisites for successful teachers of mathematics, and that this confidence stems from deep mathematical subject and pedagogical knowledge:
 - schools can improve their standards of mathematics teaching and learning by continuously developing the subject-specific expertise of one or more members of staff, in addition to the skills and capacity of these staff to support, develop and upskill colleagues across the school
 - schools without a MaST should consider drawing on the experience and expertise of schools with MaSTs. Such partnerships could provide non-MaST schools with innovative and effective practice examples for improving teaching and learning and making mathematics more accessible and relevant to children. MaST schools also stand to benefit by giving their mathematics specialists the

experience of coaching teachers in partner schools and developing their skills further.

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Appendix 1: Teacher characteristics

Key findings

- The vast majority of MaSTs who responded were female and employed full-time and a similar pattern was found for comparison teachers.
- Almost half of MaSTs surveyed were under the age of 45, with three in ten aged between 25 and 34 years. On average, MaSTs had been teaching for 11 years. Comparison school teachers had a similar spread of ages but had been teaching for an average of 15 years. The difference in mean years' teaching highlights the comparatively greater length of teaching experience of the comparison group of teachers.
- The single highest-level mathematics qualification for the majority of MaSTs and comparison teachers was a GCSE or equivalent (39 per cent and 53 per cent respectively). 15 per cent of MaSTs and 13 per cent of comparison teachers had A-level mathematics.
- About three out of ten MaSTs (31 per cent) said that they had been promoted or taken on a new responsibility as a result of their involvement in the MaST Programme. Of these MaSTs, almost half (48 per cent) reported they had become the mathematics coordinator.

A1.1 Introduction

This section outlines the characteristics of the Cohort 2 teachers participating in the survey. It provides details on: their age, gender, length of time in teaching, highest level mathematics qualification, the year groups they are currently teaching and the groups they have taught in the past. It also covers their mathematics role in the school and how their role may have changed since participating in the MaST Programme. It also presents the findings from a comparison of the characteristics of the MaST schools involved in the teacher survey to all MaST schools nationally in terms of their region, size, achievement band and eligibility for free school meals. Where appropriate, comparisons are made between the characteristics of MaST teachers and teachers from comparison schools.

An exploration of the differences in characteristics between:

- MaSTs at baseline and endpoint

- comparison teachers at baseline and endpoint
- MaSTs and comparison teachers at baseline
- MaSTs and comparison teachers at endpoint showed few significant differences in terms of characteristics.

In relation to **MaSTs at baseline and endpoint, the only significant difference between the groups was number of years teaching** (p-value=0.039) with the mean years' teaching of MaSTs at the endpoint being 10.93 years as opposed to 9.76 years at the baseline. However, since the endpoint survey was administered a year after the baseline survey, this would account for this difference. **No significant differences were found between the comparison teachers at baseline and endpoint.**

Regarding differences between the MaSTs and comparison teachers at baseline and endpoint, at both stages significant differences were found in relation to age and number of years teaching, with the comparison group of teachers being older with more teaching experience.

The age distribution for MaSTs was significantly different to the comparison group of teachers at baseline. In addition, the comparison group of teachers at baseline had been in teaching longer with the mean being 15.34 years for comparison teachers as opposed to 9.76 years for MaST (p-value=0.000). The same pattern applied at endpoint with the age distribution for MaSTs being significantly different to the comparison group of teachers. And, again, the comparison group teachers had been in teaching longer with the mean being 14.84 years for comparison teachers as opposed to 10.93 years for MaST (p-value=0.000).

A1.2 About the Cohort 2 and comparison teachers

The **majority (64 per cent) of teachers responding to the Cohort 2 MaST survey reported they were female.** It should be noted that about a quarter (26 per cent) chose not to provide their sex. However, it is likely that a greater proportion of MaSTs were female as 85 per cent of MaSTs responding to the baseline survey reported they were female. A slightly higher proportion of the comparison teachers reported they were female (71 per cent), although here again, a notable minority (16 per cent) did not answer the question (see Table F.1 in Appendix F).

As can be seen from the table below, the **teachers responding to the survey were relatively young** with almost half (49 per cent) reporting being under 45 years and the largest single group aged between 25 and 34 years (30 per cent). Interestingly, the fact that 27 per cent gave no response to this question may mask the fact that more MaSTs were of a young age. For example, the responses to the baseline survey revealed that 71 per cent of respondents were under the age of 45. The responses from the comparison group were broadly similar for gender and age split

with the exception of a higher number of teachers aged in the 55+ (eight per cent) and 35-44 categories (7 per cent).

Table A1.1 Age of Cohort 2 and comparison teachers participating in the endpoint surveys

What is your age?	MaSTs responding to the endpoint survey	Comparison teachers responding to the endpoint survey	Difference
	%	%	%
21-24	1	0	-1
25-34	30	27	-3
35-44	18	25	-7
45-54	22	23	-1
55+	2	10	-8
No response	27	15	+12
N =	324	240	

Due to rounding, percentages may not sum to 100.

Source: NFER postal survey of MaST and comparison teachers, 2012

MaSTs had been teaching for between 3 and 37 years with the mean years' teaching being 11 years (see Table F.83 in Appendix F). The comparison teachers had been teaching for between two and 36 years with the mean years' teaching being 15. Additional analysis revealed that the vast majority of MaSTs (91 per cent) worked full-time, with small proportions working four, three or two days (three, five and one per cent respectively) (see Table B.10 in Appendix B). This was very similar to the working pattern reported by comparison teachers. The difference in mean years' teaching highlights the comparatively greater length of teaching experience of the comparison group of teachers.

As can be seen from the table below, **the single highest-level mathematics qualification for the majority of MaSTs responding to the endpoint survey (39 per cent) was GCSE/O-level mathematics.** About one in seven (15 per cent) reported their highest-level mathematics qualification was an A-level in mathematics. The responses between the MaSTs and the comparison group of teachers were

broadly the same, although notably more of the comparison teachers reported that their highest mathematics-specific qualification was a GCSE/O-level.

Table A1.2 Cohort 2 and comparison teachers' highest mathematics-specific qualification

What is the highest mathematics-specific qualification that you hold?	MaSTs responding to the endpoint survey	Comparison teachers responding to the endpoint survey	Difference
	%	%	%
GCSE/(GCE) O level	39	53	-14
A level	15	13	+2
Degree	9	7	+2
AS level	1	1	0
Diploma	1	2	-1
Masters	1	0	+1
Postgraduate certificate (including PGCE)	1	0	+1
Incomplete degree or credits towards a degree	0	1	-1
CSE	0	1	-1
None	0	1	+1
Missing	31	19	+12
N =	324	240	

Due to rounding, percentages may not sum to 100.

Source: NFER postal survey of MaST and comparison teachers, 2012

The **majority of MaSTs were teaching at the upper end of primary** with almost a quarter (23 per cent) teaching year 5 and almost one in four (37 per cent) teaching year 6. Smaller proportions were teaching in nursery (one per cent), reception (four

per cent) and year 1 (ten per cent). The responses from comparison schools were broadly similar, but there was a slightly higher percentage currently teaching year 6 (40 per cent).

Table A1.3 Year group currently taught by Cohort 2 and comparison teachers participating in the survey

What year group do you currently teach?	MaSTs responding to the endpoint survey	Comparison teachers responding to the endpoint survey	Difference
	%	%	%
Nursery	1	1	0
Reception	4	6	-2
Year 1	10	10	0
Year 2	16	18	-2
Year 3	18	18	0
Year 4	18	14	+4
Year 5	23	21	+2
Year 6	37	40	+3
Secondary	2	1	+1
Further/Higher Education	0	1	-1
No response	1	2	-1
N =	324	240	

More than one answer could be given so percentages may sum to more than 100.

Source: NFER postal survey of MaST and comparison teachers, 2012

In terms of year groups that they had taught in the past, **around half of the MaSTs responded that they had previously taught year 3, 4 or 5**. Forty per cent had taught year 6 and around a third had taught year 1 and 2 (32 per cent and 35 per cent respectively). Interestingly, almost a quarter (23 per cent) had taught reception

and seven per cent had taught nursery classes. This suggests that many of the MaSTs had a good understanding of mathematics teaching and learning further down the school. The results for comparison teachers followed a similar pattern, although larger proportions of comparison teachers had experience of teaching all of the different year groups than the MaST teachers. This probably relates to their longer overall teaching experience.

Table A1.4 Year groups taught in the past by Cohort 2 and comparison teachers participating in the endpoint survey

Please indicate any other year groups you have taught in the past	MaSTs responding to the endpoint survey	Comparison teachers responding to the endpoint survey	Difference
	%	%	%
Nursery	7	8	-1
Reception	23	27	-4
Year 1	32	40	-8
Year 2	35	45	-10
Year 3	52	59	-7
Year 4	56	63	-7
Year 5	53	63	-10
Year 6	40	46	-6
Secondary	4	8	-4
Further/Higher Education	1	3	-2
No response	3	3	0
N =	324	240	

More than one answer could be given so percentages may sum to more than 100.

Source: NFER postal survey of MaST and comparison teachers, 2012

Appendix 2: Local authority areas involved in Cohorts 1 and 2 of the MaST Programme and the HEIs they are working with

DfE No.	LA	Cohort 1 only	Cohort 2 only	Cohort 1 and Cohort 2
301	Barking and Dagenham		Institute of Education	
302	Barnet			Institute of Education
370	Barnsley	Sheffield Hallam University		
822	Bedford Borough		Northampton	
303	Bexley		Winchester	
330	Birmingham			Edge Hill University
350	Bolton			Manchester Metropolitan
380	Bradford			Sheffield Hallam University
304	Brent			Institute of Education
846	Brighton and Hove			University of Brighton
801	Bristol, City of		Open University	
305	Bromley	Institute of Education		
825	Buckinghamshire			Winchester
351	Bury		Manchester Metropolitan	
381	Calderdale	Manchester Metropolitan		
873	Cambridgeshire			Northampton
202	Camden			Institute of Education
823	Central Bedfordshire			Northampton
896	Cheshire East			Edge Hill University
895	Cheshire West & Chester			Edge Hill University

908	Cornwall			Open University
331	Coventry	Edge Hill University		
306	Croydon	Institute of Education		
909	Cumbria			Manchester Metropolitan
831	Derby			Northampton
830	Derbyshire			Northampton
878	Devon			Open University
371	Doncaster			Sheffield Hallam University
835	Dorset			Winchester
332	Dudley			Edge Hill University
840	Durham			Open University
307	Ealing		Institute of Education	
811	East Riding of Yorkshire			Sheffield Hallam University
845	East Sussex			University of Brighton
881	Essex			Winchester
390	Gateshead			Open University
916	Gloucestershire			Winchester
205	Hammersmith and Fulham		Institute of Education	
850	Hampshire			Winchester
309	Haringey			Institute of Education
310	Harrow		Institute of Education	
311	Havering			Institute of Education
884	Herefordshire		Edge Hill University	
919	Hertfordshire			Northampton
312	Hillingdon			Winchester
313	Hounslow			Institute of Education

206	Islington		Institute of Education	
207	Kensington and Chelsea		Institute of Education	
886	Kent			Winchester
314	Kingston upon Thames			Institute of Education
382	Kirklees			Manchester Metropolitan
208	Lambeth			Institute of Education
888	Lancashire			Edge Hill University
383	Leeds			Sheffield Hallam University
856	Leicester			Northampton
855	Leicestershire			Northampton
209	Lewisham			Institute of Education
925	Lincolnshire			Northampton
341	Liverpool			Manchester Metropolitan
821	Luton		Northampton	
352	Manchester			Manchester Metropolitan
887	Medway			Winchester
826	Milton Keynes			Northampton
391	Newcastle upon Tyne		Open University	
926	Norfolk	Institute of Education		
802	North Somerset		Open University	
392	North Tyneside			Open University
815	North Yorkshire			Sheffield Hallam University
928	Northamptonshire			Northampton
929	Northumberland			Open University
892	Nottingham			Northampton

891	Nottinghamshire			Northampton
353	Oldham			Manchester Metropolitan
931	Oxfordshire			Winchester
874	Peterborough		Northampton	
879	Plymouth			Open University
870	Reading		Winchester	
318	Richmond upon Thames		Institute of Education	
372	Rotherham	Sheffield Hallam University		
857	Rutland	Northampton		
355	Salford			Manchester Metropolitan
333	Sandwell			Edge Hill University
373	Sheffield			Sheffield Hallam University
893	Shropshire	Edge Hill University		
871	Slough	Institute of Education		
334	Solihull			Edge Hill University
933	Somerset			Open University
803	South Gloucestershire			Winchester
393	South Tyneside			Open University
852	Southampton		Winchester	
210	Southwark	Institute of Education		
342	St. Helens			Edge Hill University
860	Staffordshire			Edge Hill University
356	Stockport			Manchester Metropolitan
808	Stockton-on-Tees			Open University
861	Stoke-on-Trent			Edge Hill University

935	Suffolk			Northampton
394	Sunderland			Open University
936	Surrey			University of Brighton
866	Swindon		Winchester	
357	Tameside			Manchester Metropolitan
894	Telford and Wrekin			Edge Hill University
880	Torbay		Open University	
211	Tower Hamlets			Institute of Education
358	Trafford	Manchester Metropolitan		
384	Wakefield			Sheffield Hallam University
335	Walsall			Edge Hill University
320	Waltham Forest			Institute of Education
212	Wandsworth			Institute of Education
877	Warrington			Manchester Metropolitan
937	Warwickshire			Northampton
869	West Berkshire			Winchester
938	West Sussex			University of Brighton
359	Wigan			Edge Hill University
865	Wiltshire			Winchester
868	Windsor and Maidenhead		Winchester	
344	Wirral			Edge Hill University
336	Wolverhampton			Edge Hill University
885	Worcestershire		Edge Hill University	
816	York		Sheffield Hallam University	



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