National Centre for Excellence in the Teaching of Mathematics

MathsHUBS

England-China Teacher Exchange

In the summer term 2015 the Lead Primary Schools (the LPS) involved in the exchange were asked to report:

- how they have continued to develop mathematics teaching and learning since the 'home leg' of the exchange took place;
- what they feel the impact has been over this longer period of time;
- how they intend to continue to develop implementation of teaching for mastery in the coming school year.

This report summarises the key themes emerging from the set of LPS reports. It is a continuation of the first NCETM report, which summarised the LPS' immediate 'post-home leg' reflections and findings. In this report the term '***Lead Teachers***' refers to the staff (mainly, but not solely, teaching staff) who have been directly involved in the exchange programme and who are now involved in wider dissemination within their schools and their local and wider Hub networks.

Above all else, the features that come through strongly (and which demonstrate the positive impact of the project) are:

- the commitment LPS leadership teams have shown to developing approaches to teaching for mastery and to using these to build on existing strengths;
- the depth of understanding of the pedagogy underpinning teaching for mastery that the Lead Teachers have developed and honed through the exchange;
- the careful thought being given to the provision of support for staff in order to maximise the success of longer-term implementation;
- the focus on and prioritising of setting up collaborative partnerships between staff;
- the understanding the Lead Teachers have that they are embarking on a long journey of professional development and that they are still in the early stages of this journey;
- the range of ways that the Lead Teachers are working within their local networks and, increasingly, more widely across their Maths Hub.

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2014-15: Review

The LPS were asked to respond to the following questions in relation to the five key aspects of Shanghai-style teaching (teaching for mastery, calculation practice and developing number fluency, lesson design, effective use of high-quality Shanghai textbooks, assessment and feedback of class- and homework):

- What have you done following the visit of the Chinese teachers to develop your understanding of this aspect?
- What has been the long-term impact on your professional practice?
- What evidence do you have of this impact?
- What has been the long-term impact on your pupils'
  - procedural fluency?
  - conceptual understanding?
  - and their attitude to maths?
- What evidence do you have of this impact?
- What steps will you be taking next year to secure your understanding and practice of this aspect?

When discussing the impact of initiatives, Lead Teachers have used a range of evidence sources. These have included:

- Informal and formal feedback from staff (both teaching and support)
- Learning walks
- Lesson observations
- Scrutiny of written lesson designs and children's books
- Feedback from children, collected both in informal ways and in more systematic ways (for example, using pupil attitudinal surveys)
- Attainment data

It is clear that some LPS have adopted quite systematic approaches to gathering evidence of impact, while others are approaching this in more informal ways. Identifying evidence of impact through analysis of attainment data has been a worthwhile undertaking for the LPS, but has been easier in the schools in which the Shanghai teachers taught Y2 and/or Y6 classes since national test data are available for these age groups. Rigorous statistical analysis could be undertaken in order to draw statistically quantifiable conclusions, but to do so at this early stage does not seem justified.

1. Teaching for Mastery

Lead Teachers' comments show clearly that they have already developed a strong understanding of teaching for mastery, and that this understanding is also developing quickly in their colleagues. LPS have devoted a considerable amount of time and resource to focused staff development in this area in recent months. For example, one school has been able to give all the teachers an extra afternoon's release each week to enable them to develop their own pedagogical understanding, observe colleagues teaching, and work collaboratively with colleagues.

In particular, Lead Teachers are working with teachers to review and change the way they think about differentiation. A fundamental principle of teaching for mastery is that all children are taught

the same concept at the same time: every child begins the lesson with the conceptual foundations necessary for the lesson to build from, and every child reaches the expected level of understanding before the next lesson. Lead Teachers are helping classroom teachers move away from giving some children an accelerated curriculum but instead giving the pupils who grasp ideas more quickly than their peers additional intelligent practice on the **same** topic, to lead these children to develop **deeper** conceptual understanding of this topic. No longer is there 'differentiation of content' from the start of the lesson, but there might – if needed, later in the lesson – be this 'differentiation of tasks'. Linked to this, many LPS are moving away from putting children in ability sets, or in in-class ability groupings, for mathematics, and teachers are stopping using *a priori* labelling such as 'higher ability' but instead are using language that reflects children's attainment hitherto. They have also been allocating longer blocks of time to the teaching of each mathematical topic, thereby enabling deeper learning to take place, and they report that the teachers are increasingly resisting the temptation to move on before all the children have mastered the topic securely.

Many Lead Teachers have been focusing strongly on classroom discussion, in particular the way teachers ask questions and the way children are encouraged to explain their own mathematical reasoning, using full sentences and correct mathematical terminology. The increased focus on the identification of common misconceptions in different topics has led to changes in the ways lessons are designed, as has the increased understanding of how to use variation to develop the children's procedural and conceptual understanding. A few LPS specifically mentioned that they have found the Shanghai textbooks very useful as a way of developing their understanding of how to build meaningful and effective variation into the examples and exercises they devise for their classes, as well as how to develop purposeful variation in the pictorial representations of mathematical concepts.

Most Lead Teachers referred explicitly to the use of collaborative approaches to lesson design, which aim to help staff develop their own understanding of teaching for mastery. Lead Teachers recognise the critical importance of strong subject knowledge if teaching for mastery is to be successful. Commonly observed impacts of these approaches have been:

- Lead Teachers feel that the idea that all children should be able to master each mathematics topic is already embedded within their school ethos, and that colleagues' understanding of the concept of teaching for mastery is developing quickly.
- Lead Teachers are seeing improved lesson design by their colleagues, with a sharper focus on key learning within each lesson and the small-step progression required to achieve this learning.
- Teachers report that they are enjoying teaching mathematics more than in the past, and that the discussions with children about their mathematical reasoning are becoming richer and more informative.
- Children have increased confidence about applying their knowledge and understanding when solving problems, and are more secure about seeing the links between different mathematical concepts.
- Children say that they enjoy the approaches used and the challenges they are given. Most LPS say that the children's attitudes to mathematics have improved, and many particularly identify that this has happened with children who formerly had been attaining at a lower level than their peers. These children are now, for example, less likely to give up when they encounter something hard.
- A number of LPS noted that they are already seeing that the attainment gap within classes is narrowing through the increased performance of previously low attaining children.
- Collaborative approaches to lesson design are leading to improved teacher subject knowledge.

- Some LPS have identified the need for new approaches to assessing children's learning and progress.

Looking to the future, all the LPS have plans for the continued dissemination of the new approaches. The LPS are clearly thinking carefully about where best to focus their development work, responding both to their own and local needs, while also recognising that there is still a long journey ahead, and that each step along that road needs to be secure. Some LPS have said that one or more of their teachers have applied for NCETM's Primary Mathematics Teaching for Mastery Specialists' programme, and they expect that their acceptance on this programme will further strengthen their development work in this area. One LPS mentioned plans to consider the implications for Y6/Y7 transfer.

A point raised by some of the LPS is the challenge of reducing the amount of 'differentiation by task', especially in mixed age classes. To some extent this might be a transitional issue (one lead teacher is already thinking about what it will be like when teaching for mastery is embedded from Reception upwards), but there will continue to remain the challenges of meeting the needs of the children with significant special educational needs, and these will always need sensitive consideration.

2. Calculation practice and developing number fluency

All the LPS have continued to develop their implementation of the approaches to teaching calculation used by the Shanghai teachers, and many specifically mentioned that they are reviewing their calculation policies to take account of these approaches. In their development work with colleagues, Lead Teachers have been focusing on:

- the importance of children developing deep conceptual understanding of their calculation strategies and methods, and the importance of using procedural and conceptual variation, visual images and manipulatives to achieve this;
- the importance of careful lesson design in order to keep a sharp focus on the key concept at the heart of the lesson, and of intelligent practice that supports conceptual understanding and fluency in calculation;
- the importance of children learning efficient methods of calculation and being able to make good decisions about what methods to use;
- the importance of children in Foundation Stage and Key Stage 1 developing a strong sense of number and of developing their ability to solve number problems by efficient calculation methods (for example partitioning numbers, bridging to 10 and using knowledge of place value, rather than counting on);
- developing the clarity of the non-negotiables for each year group, for example the number facts that all children in each year group need to know fluently;
- developing the quality of pupil discussion so that the children are more confident at explaining their reasoning fluently and coherently;
- the value of daily oral practice of essential number facts so that fluent recall enables efficient calculation when needed (e.g. when solving a problem);
- reviewing the structure and timing of lessons.

A number of LPS have run workshops for parents and carers to explain the changes in the way they are teaching, and these have been well received.

Lead Teachers consider that other teachers in their schools are now more confident about how to teach calculation (for example, as a result of a sharper focus on children's misconceptions and of the development of their understanding of variation) and are aware of the importance of not moving on to a new topic prematurely. The impact on the children is seen in improved fluency and accuracy (including the ability to choose an efficient method), improved mathematical reasoning, and improved application of calculation methods in problem-solving. Children are also spotting patterns and relationships more readily, which is evidence of their improved conceptual understanding, and many LPS report that the children are more confident, and more accurate, in their use of arithmetic. In the months ahead, Lead Teachers intend to focus on the consistent implementation across their schools of their revised calculation policies that support (and exemplify) teaching for mastery.

3. Lesson design

LPS have been reviewing the structure of their mathematics lessons, and making changes which they feel support the implementation of teaching for mastery more effectively. They have been doing this in a number of ways, responding to their own contexts, but many Lead Teachers report that they have been involved in collaborative lesson design with colleagues. The impact of this has been enhanced discussion amongst colleagues about key features of lessons such as:

- what the 'difficult point' is of a lesson, and how to approach this to ensure that all children understand it;
- what the likely misconceptions are, and how these should be addressed and deconstructed rather than side-stepped;
- what children need to have mastered by the end of the lesson, and what the small steps are that are needed to achieve this;
- the effective use of questioning strategies such as "What's the same? What's different?" and "Is this always, sometimes or never true?"

In some LPS the collaborative approach to lesson design has been extended to enable teachers routinely to observe each other. Some LPS have changed lesson design templates in order to support the focus on these key features; some are starting to develop shared on-line resource banks (within their own schools and also within their wider networks) to support lesson design, for example with information about common misconceptions, or through developing a bank of slides for interactive whiteboards. The importance of using (indeed, embracing) misconceptions as teaching points in lessons was explicitly mentioned by many Lead Teachers, often accompanied by recognition of the importance of having a visualiser so that children's work can quickly be shared with the whole class – especially when a pupil's written mathematics demonstrates an effective method or a common misconception.

A number of Lead Teachers have seen that the new approaches to lesson design have led to improved retention by the children of what has been taught, which in turn leads to improved progress, with many LPS reporting this particularly with children who formerly have been low attainers. One LPS summarised the wider impact on the children's learning as follows:

"The pace has slowed, yet better maths is being taught as the teachers (and pupils) have a securer/deeper understanding. There is now more opportunity to build on prior knowledge and to apply what they know. Teachers ask far more, richer questions and allow for thinking/exploration time without the feeling the pressure of moving on. Children ask far more questions and are expected to question each other. They have far more ownership of their learning. Expectations have risen and they expect to be asked 'how' or 'why' and give reasons to solutions. They are keen to contribute, and are not frightened of getting the wrong answer or making mistakes. All children believe they can achieve. They have a more structured approach to maths and know what to expect yet at the same time have far more freedoms to explore the maths. They love it!"

The points covered in this quotation reflect many comments made by other LPS. One school has identified that it is not yet happy with aspects of its teachers' lesson design, in particular in relation to meeting the needs of higher attaining children. Several LPS report that new approaches to lesson design are currently adding quite significantly to teacher workload: one lead teacher commented that *"I am taking much longer planning lessons as I want each step to contribute to the learning"*. Next year, Lead Teachers aim to develop the quality of lesson design further across their schools. In

one LPS, the lead teacher will be released from class teaching for the term in order to work regularly with colleagues on lesson design; this will include focused support for a newly qualified teacher.

4. Effective use of high-quality Shanghai textbooks

Not all the Shanghai teachers brought with them the textbooks they use, and some LPS have commented on the need for the textbooks to be translated into English in order for teachers to have the full benefit, but those who have had access recognise the way the content of the textbooks exemplifies the use of intelligent practice to support the development of conceptual and procedural understanding, and they would agree with these comments from four LPS:

"We are very aware that the textbook in Shanghai is used to support lesson design and not replace it."

"The text books have been extremely useful in helping to design lessons, by seeing how the concepts have been broken down into small steps, seeing what concrete and pictorial representations have been used to explore the concept and to plan for progression. Because the text books break down concepts into small steps and just focus on one particular concept, this has ensured that all children have had a chance to succeed."

"I now use the Shanghai textbooks to inform my number lessons. I use the calculations in the textbook to allow children to identify patterns and connect their mathematical thinking (e.g. what do you notice about 22 + 17 and 27 + 12?)."

"The text books provide quality pictorial representations that help children to grasp complex mathematical concepts."

A number of LPS are also involved in the Maths Hub National Collaborative Project to explore the use of text books that follow the Singapore curriculum (either *Maths - No Problem!* or *Inspire Maths*), and the teachers in these schools are identifying ways in which these resources can also be used to support teaching for mastery.

5. Assessment and feedback of classwork and homework

Lead Teachers recognise that ensuring that the children get quick feedback on their work, and that there is same-day intervention for those who need it, are practices that are central to ensuring that all children master new mathematical topics and concepts. Some of the key messages from LPS are:

During lessons
Many LPS have seen that the increased quality of discussion in lessons (linked to increasingly sophisticated teacher questioning) gives teachers valuable formative information about the children's conceptual understanding which can be then used to adjust the flow of the lesson, amend the next lesson, and identify children who need rapid extra support. Children have responded very well to this way of working, and are mostly keen to discuss their reasoning, even if their answer is wrong. Many Lead Teachers commented on the importance of having a visualiser in order to share children's work. Children are motivated by the quick feedback they are getting, feeling that it helps them develop their understanding of their work.

Same day intervention
Many LPS feel that same day intervention (SDI) is having a real impact on children's learning, with children responding positively to this. LPS are implementing SDI in different ways, sensitive to local resourcing and timetabling issues. One issue is the need to give staff the time to mark the children's work – some have found ways to give teachers a small amount of release time for this. Another issue is to ensure that all staff involved in running SDI sessions have the necessary pedagogical skills and subject knowledge.

Homework
Many LPS are reviewing their use of mathematics homework and starting to make changes to what the children are being asked to do and how often homework is set, for example having more frequent but shorter homework tasks. Some feel that the homework is now much more closely linked with the content of the lesson and this makes it more effective for the children, as well as helping to communicate with parents and carers about the new approaches.

2015-16: Next steps and future plans

Developing the use of specialist mathematics teachers

Since hosting the visiting teachers from Shanghai earlier in the year, LPS have been considering the use of specialist mathematics teachers as a part of their implementation of teaching for mastery. So far only a few of the LPS have gone down this route, with others identifying organisational and budget constraints that make it difficult for them to do this at the present time. Despite these constraints, a number of LPS are planning to explore possibilities in the next school year. Challenges to be addressed that Lead Teachers have identified include:

- the use of specialist mathematics teachers may de-skill other teachers;
- with some teachers teaching more mathematics lessons, other teachers are teaching more English lessons, leading to a significant increase in the amount of marking of children's work for those teachers;
- if Lead Teachers are released to do more specialist mathematics teaching, their own classes can be adversely affected in other curriculum areas.

Leading the development of the five key aspects

Lead Teachers have clearly put an enormous amount of time and energy in recent months into working with colleagues to develop understanding of the pedagogical principles of teaching for mastery and of how to implement these in the classroom. With other major changes in the curriculum and approaches to assessment currently underway in schools, they have had to be mindful of the pressures that colleagues are under.

In their reports, Lead Teachers make many comments about the critical importance of working collaboratively in their own schools and within their wider local and Hub networks in order that colleagues can develop their own understanding of these new approaches. At the same time, they are sensitive to the fact that effective change takes time and that in particular there is a need for teachers to be able to be released from their class teaching commitments on a regular basis in order to observe other classes, to meet and plan collaboratively, and to develop the effectiveness of teacher research groups. While LPS and Maths Hubs have been able to use available budget for these purposes, this has not always been sufficient to cover every desired arrangement of small groups of teachers meeting regularly during school time; some small LPS have found budget pressures particularly challenging.

Clearly there are challenges around ensuring longer-term sustainability and the development of consistently high quality teaching for mastery throughout schools. In response, Lead Teachers have identified a number of strategies that they have found to be effective for working within their own schools and within wider networks.

- Creating opportunities for colleagues to observe 'exemplar' lessons. Lead Teachers report that this is particularly valuable when more than one teacher can observe and when there is both pre- and post-lesson discussion. It is also valuable when colleagues can observe the same lesson being taught to different classes, and when the observation and pre- and post-lesson discussions are carefully planned and structured. Observation of 'exemplar' lessons can help convince more sceptical colleagues of the potential of the new approaches, and some Lead Teachers feel that it is particularly effective if they teach the classes of their colleagues, not always their own classes.
- Developing lesson study type approaches, when teachers jointly plan, teach and observe one or more lessons.

- Video recording of lessons (e.g. using Iris Connect) so that colleagues can observe lessons at other times, hence reducing the need for classroom release. Some LPS are building up a resource bank of recorded 'exemplar' lessons.
- Working closely with colleagues over a period of time to develop the new approaches to lesson design. This is helping colleagues to see how progression can be planned for over the medium term and to develop their deeper understanding of the underlying pedagogical principles of teaching for mastery, such as the use of variation and intelligent practice.
- Developing teacher research groups (TRGs). One lead teacher commented that the TRG has *"created a real 'buzz' about maths in the school. Having a group of people who regularly meet to discuss maths has kept it in focus and they are motivated and interested"*.
- Resource development. Many Lead Teachers have developed resources to support colleagues in lesson design, for example material about common misconceptions or examples of how to develop conceptual and procedural variation in different mathematics topics. Many comment that it would be sensible and welcomed if such resources were developed at a national level.

It is very encouraging that all the LPS report that their neighbouring schools (and sometimes not-so neighbouring ones!) have shown a high level of interest in the project: the LPS have welcomed many visitors who have come to observe lessons and engage in TRGs. LPS have been active within their local networks, and some have been able to organise larger-scale, and well-received, forums to reach a wider audience. In these events, Lead Teachers still recognise that the most powerful way to stimulate change is for other teachers to be able to observe teaching for mastery in action with real classes, but they note that care needs to be taken to ensure that other teachers do not go away with a 'watered down' understanding of teaching for mastery: observing one 'exemplar' lesson is only the first step of a teacher's professional development journey in teaching maths for mastery.