


Developing mathematics in Primary Schools

Headteachers talk about creating
and sustaining excellence in the
teaching of mathematics



National Centre
for Excellence in the
Teaching of Mathematics

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Foreword



One of the greatest challenges facing headteachers is the recruitment and retention of good teachers of mathematics. The situation whilst particularly acute in our inner cities is also to be found in rural areas. The National Centre for Excellence in the Teaching of Mathematics (NCETM) commissioned a case study in 2008 based in seven challenging inner-city schools to examine how leaders have found local solutions to national problems, especially in the area of recruitment and retention of mathematics staff. This case study, 'Developing mathematics in London Secondary Schools' was well received and the NCETM decided to widen the remit to include a wider range of schools nationally, and importantly in the Primary sector.

This document is the result of the wider study. The strategies identified are very similar to those in the first case study and many of the local solutions seem independent of location and school type. It forms a crucial part of our ongoing work with school leaders and discusses the strategies employed by diverse a group of senior leaders in developing and sustaining good mathematics departments, often in challenging circumstances.

The NCETM aims to support teaching and learning in mathematics by improving the quality and availability of professional development for all teachers of mathematics. Our approach is to identify, share and develop good practice and expertise wherever it exists. The NCETM believes that school leadership is a vital component in developing successful teaching and learning in mathematics, so an important part of its remit is to work collaboratively with senior leaders in schools to find ways to improve mathematics provision. These two studies form part of this strand of the NCETM's work.

The NCETM works with many different stakeholders, from initial teacher education to senior leadership, with the aim of ensuring that the workforce of mathematics teachers has the opportunity to grow and learn professionally. We are certain that it is only by this collaborative effort that we can provide the best mathematics education for our young people. This study is only a part of our work with senior leaders. The central role of headteachers in the development of mathematics education is unquestionable. We would welcome ideas and feedback as to how we can disseminate and elaborate this important message. For more information please contact us by visiting the NCETM portal www.ncetm.org.uk or email info@ncetm.org.uk

A handwritten signature in black ink that reads "Celia Hoyles".

Professor Celia Hoyles OBE

Director, National Centre for Excellence in the Teaching of Mathematics

Introduction

The London Study

Initially, the NCETM selected seven secondary schools from London as part of a study of how schools create, develop and sustain good mathematics departments. The schools all face challenging circumstances with most of them situated in areas of high social priority, with above average free school meals and significantly high levels of EAL (English as an Additional Language). All of the schools are situated in areas where house prices are high and staff recruitment is an issue. Six headteachers and one deputy head were interviewed in depth about how they have developed their mathematics department, increased levels of attainment in mathematics and ensured a healthy supply of mathematics teachers.

Extending the study

Whilst we are confident that the strategies and approaches are not particular to the schools in the London study, the fact that all seven schools were inner city secondary schools in one area of London, prompted us to explore practice across a wider range of schools. Eight primary or lower schools across the country were identified as having mathematics provision that indicates good and/or improving practice that will be of interest to other schools seeking to improve their own provision.

This study describes the work that the seven primary schools and one lower school are doing to develop the quality of learning and teaching of mathematics. All the schools demonstrate through their work their commitment to the continuing professional development of their staff. The headteachers and mathematics subject leaders are fully aware that supporting colleagues in the development of their subject knowledge and pedagogical understanding is central to their aims of increasing children's understanding and motivation, and that this is the bedrock of improved attainment in mathematics. Inevitably the schools in this study have a wide range of development priorities. Leaders in these schools are highly creative at finding ways to maintain the focus on developing mathematics in what are often crowded development agendas.

The schools vary greatly. One school has been judged to be outstanding in its last two Ofsted inspections and they recognise that this gives them flexibility in the ways they develop in the future. Another of the schools has, with new leadership, recently come out of Special Measures and school improvement has to remain very tightly focused on standards, behaviour and attendance for the immediate future. The eight schools serve very different communities, from small village communities to urban areas with high levels of social deprivation, schools with wide ethnic diversity to ones that are predominantly mono-cultural. One school has a significant number of children who have recently arrived in this country speaking little or no English, while another includes a large traveller community in its catchment

area. In some of the schools parents are keen to be involved and communication with families is relatively straightforward. In others engaging parents in their children's schooling is a real challenge. One school is a five class lower school, while another has over seven hundred children on roll. The ambition of raising the levels of children's attainment in mathematics is a shared one, but the strategies used vary from school to school. Local solutions depend on the recent histories of the schools, the communities they work with, the experience and expertise within the schools, and the support available from wider networks.

But the leaders in the schools have much in common. They have a critical approach to school development based on a rich understanding of their strengths and development needs. This knowledge of their schools is based on high quality data, both 'hard' and 'soft', which is used well to identify how best to use the finite human and material resources at their disposal to effect maximum change. All the schools, of course, are focused on improving children's test scores. But equally they all know that this can only be achieved in a sustainable way if due attention is given to the important underlying features of high quality teaching and learning. None of the schools sees the development of mathematics teaching and learning in isolation. It is a part of the wider work they are doing to provide the best possible education to all their children. In that sense all the schools are working in holistic ways.

Exploring the rich range of approaches to common aspirations has made this study particularly enlightening, based as it is on in-depth discussions with headteachers and mathematics subject leaders. Our hope is that the stories in the report will support others in their own development work, prompt discussion and encourage new and imaginative thinking.

Executive Summary

There is much in this report which resonates with the key messages in the NCETM report 'Mathematics Matters'. 'Mathematics Matters' established key learning outcomes which attract broad support among the mathematics teaching community, articulated features of effective mathematics teaching, identified obstacles to further progress and considered ways forward. This report identifies ways that headteachers and subject leaders in eight schools are approaching the reality of creating effective and sustainable change in mathematics teaching and learning.

Ethos and Leadership

In all the schools in this study it is clear that the role of the headteacher in establishing and maintaining a positive staff ethos is critical. Headteachers all want their staff to have the skills, knowledge and confidence to make their own well founded decisions about the curriculum in the best interests of all the children in their classes. They work hard and effectively to bring this about. The schools all have highly enthusiastic and committed subject leaders who have a significant impact on their colleagues. Opportunities to work outside the school add to the quality of their leadership. The quality of support from local authority advisory teachers is recognised and valued, but is often a scarce resource.

Developing subject knowledge and pedagogical understanding

The schools recognise that developing subject knowledge and pedagogical understanding is one of the cornerstones of effective school improvement. While external accountability processes such as Ofsted inspections influence the direction of school improvement, the headteachers of all the schools are committed to developing collaborative working practices. They seek to use the expertise and energies of their staff to bring about sustainable change, and are often highly creative in finding ways to do this within finite human and financial resources. Senior staff have excellent understanding of the strengths and relative weaknesses of their schools and use this information powerfully to guide school improvement.

Embedding the Use and Application of mathematics

All the schools in the study are fully aware of the importance of embedding the Using and Applying strand of the mathematics curriculum. Special activities such as Maths Weeks are a powerful way to highlight Using and Applying, but schools are at different stages in terms of embedding this securely in every lesson. The level of teachers' subject knowledge and confidence is acknowledged as a critical factor.



Engaging children in their own learning and personalised learning

All the schools are keen to develop ways in which children are encouraged to take greater responsibility for their own learning, and have been very imaginative in finding ways that work well within their own communities. Most of the schools in the study are at a very early stage of developing the use of virtual learning environments to enhance children's engagement. All the schools have developed high quality pupil tracking systems which underpin target setting and intervention work. Curriculum targets are used in all the schools in a variety of forms, but schools often review these as they seek to find the right balance between their impact on learning and their manageability.



Class organisation

Larger schools have the option of setting by ability for mathematics. The larger schools in the study have all considered this and are aware of a range of issues that can influence whether setting will enhance attainment or not. The schools adopt pragmatic positions and review arrangements in the light of experience.

Using ICT to support learning

The schools recognise that ICT has the potential to enhance mathematical understanding while recognising that concrete experience remains an essential part of learning. The schools vary in the extent to which they find the interactive teaching programs from the Strategy website valuable, and look for support from a wide range of published resources. Teachers are alert to the way that software such as spreadsheets can be a valuable aid in cross-curricular work, and a number of actively engaged in using their school Virtual Learning Environment (VLE). Other schools are examining how they can embed the use of generic online resources such as Google Earth into their teaching of mathematics.

Working with parents

All the headteachers devote time and energy to helping parents become more involved in their children's education. In some communities this is particularly challenging and imaginative approaches are adopted in order to break down barriers between home and school.

Ethos and Leadership



The headteachers in all the schools in the study are all clear that developing a positive staff ethos is an essential foundation of successful school development and that this cannot be taken for granted. Some of the headteachers inherited situations where work needed to be done to develop collective and consistent responsibility for improvement. The headteachers know that they need staff who have the confidence to make their own well founded professional decisions, to innovate and experiment in order that the children's learning can be maximised. Developing this is done in many different ways.



At Milton Hall the headteacher encourages staff to develop creative approaches to learning and to take risks and her skill at finding extra external funding means that such innovations can often be supported with enhanced resources. The headteacher and subject leader at St Philip's recognise that the positive ethos they nurture depends on openness and honesty between all staff. An early decision by the new headteacher at Fairstead was to appoint a business manager, who became a member of the senior leadership team. This has allowed the headteacher to focus on the urgent issues of changing attitudes to learning in the school among both children and some staff.

The headteacher and co-headteacher at Hayes Park are committed to the idea of using coaching as a way of encouraging staff to take ownership of their own development. This aims to develop collective responsibility and to make staff development bottom-up rather than top-down. They have trained many of the staff, including some teaching assistants, as coaches and coaching has become an important way in which development needs are identified and responded to. They use the school's VLE to add further to this process by setting up spaces to share ideas and discuss issues. For example, teaching assistants have their own chat room, and discussions on this have allowed the teaching assistants to identify a shared desire to develop high quality questioning. Staff are now using coaching with Year 6 children in order that the children take greater responsibility for their own learning. Children are encouraged through coaching sessions to identify their own learning needs and what they are going to do to achieve these.

Subject leaders in the study schools are all passionate about mathematics, although they were not necessarily particularly good at the subject at school themselves. This passion is something that communicates to other staff and to children and helps create an enthusiasm about mathematics throughout the school, increasing the likelihood of children saying 'I love maths!'. In one school this the subject leader encourages colleagues to send children who have done interesting or unexpected mathematics to her. In this way she communicates the idea that creativity in mathematics is valued. These ambassadors for mathematics are well placed to develop into the

mathematics specialist role envisaged by the recent Williams Review. Subject leaders in the schools have varying amounts of dedicated leadership time, this depending on the size of the schools and wider budget constraints. Leadership time, however, means time away from the class and one school feels that they would not increase this even if they were able to afford it.

Some of the larger schools have two subject leaders for mathematics. This can make it easier to provide quality leadership from the Foundation Stage to Year 6 and also makes it easier to maintain continuity if and when one of the teachers leaves the school. In these situations, the two teachers enjoy being able to work collaboratively, bringing different expertise to the partnership. Subject leaders acknowledge that having a rich understanding of mathematics right across the primary age range is very difficult to achieve.

Wider networks contribute further to the quality of leadership. At Hayes Park the subject leader is an Advanced Skills Teacher (AST) and she is very aware that the outreach work she does in this role has a significant impact on her work with her own colleagues. She finds that she learns a huge amount from her outreach work, and she is able to exploit this in working with colleagues in her own school. At Silsoe the headteacher was formerly an AST and likewise recognises the positive impact that working in a range of schools has had on her own leadership. At St Peter and St Paul the subject leader has for many years been a Leading Mathematics Teacher in the local authority and has been an enthusiastic member of curriculum development projects led by the advisory team. Subject leaders in several of the schools value highly the support of local authority advisory teams, although this resource is often limited for schools judged to be successful.

Developing subject knowledge and pedagogical understanding

All the schools recognise that developing subject knowledge and pedagogical understanding is an on-going process which lies at the heart of school improvement. For the most part the schools' latest Ofsted reports have not identified specific areas in mathematics that need attention. It is more common to encounter wider issues relating to, for example, approaches to assessment, the use of assessment data, the opportunities children have to engage in collaborative problem solving, or the provision for higher attaining children. Such issues all need to be considered within the teaching of mathematics as well as in other curriculum areas. The schools have responded to these challenges in ways which shows clearly that they have the confidence to be innovative.

All the schools devote significant time to collaborative working within their schools. Subject leaders try to ensure that the time they spend in colleagues' classrooms is seen more as collaborative working than formal monitoring of teaching. Joint planning, team teaching and mutual observation are all recognised as powerful agents of change. All recognise that much has been gained from the implementation of the numeracy strategy in recent years, but subject leaders are keen that their colleagues develop the ability and confidence to meet children's learning needs in more flexible ways. This vision underpins the ways they seek to develop mathematics in their schools.

In 2006 Silsoe's Ofsted report indicated that children needed more open-ended activities that require children to use and apply their problem solving skills, especially in mathematics. When the staff reflected on this they decided that a contributory factor was an over-reliance on a published mathematics scheme. They decided they needed to plan directly from the numeracy strategy, making use of published resources only when appropriate, and to ensure a more practical approach throughout the school rooted in investigational work, with an emphasis on problem solving and clearly planned extension activities. This was not an easy transition for all staff, but through collaborative working and clear leadership it has been successful. Attainment in mathematics has risen, and the work in this area was a significant factor in the school being judged as outstanding in its most recent inspection.

At Fairstead the school was subject to termly monitoring HMI visits while it was in Special Measures. The headteacher felt that even more formal classroom monitoring would have been demoralising and so she was keen to develop a peer coaching approach to lesson observation where the observation is used as the basis for dialogue and discussion. This has helped the staff feel ownership of, and engagement in, the process and hence has had clear impact on the quality of teaching. Working with a local authority advisor the school has also developed team teaching opportunities where, for example, three teachers jointly plan a lesson and then one is the lead



teacher with the other two supporting. They explain to the children that this is part of the teachers' learning. This approach has developed team spirit, broken down barriers between teachers and teaching assistants, and contributed to the rising percentage of lessons graded as good or outstanding by HMI on their visits. This approach is now being shared with other schools.



Identifying accurately the development needs of staff tends to be harder in larger schools. At Hayes Park, the largest school in the study, a range of approaches is used. They have a rolling CPD programme which is based on a model whereby they spend one term gathering information about a curriculum area, and then the next term is spent responding to the needs identified. Their Teaching and Learning team consists of all the subject leaders led by the co-headteacher. They work collaboratively monitoring practice, sharing their perspectives on the quality of teaching and learning. The school is unusual in having four ASTs. These teachers are paired up so that each pair shares a class. This means that in addition to doing one day a week outreach work, they also are able to spend a day a week working directly with colleagues within the school. This approach adds a further depth to the school's development work.

Subject leaders have found it extremely valuable spending time developing clarity about their calculation policies, looking at the particular methods that will be taught and the related vocabulary that will consistently be used. At St Peter and St Paul the subject leader found this took much longer than anticipated, but that the time given to this has proved to be invaluable as teachers across the school have a much better understanding of how what they are teaching fits into a bigger picture. The subject leader recognised that it was important to give this discussion the time it really needed, and not feel rushed to move on to another development priority. The discussions also opened up deeper conversations about the structure of the number system, and this has helped to enhance subject knowledge. Some local authorities provide excellent guidance about calculation policies, and schools have found these to be very useful starting points.

Opportunities to link with other schools can also contribute strongly to staff development. At Milton Hall a recent staff training day was set up to enable every teacher to visit another local school with a particular focus on observing mathematics lessons. Much came from this rich experience with ideas shared and new friends made. The visits also helped staff acknowledge their own good practice. The Key Stage 2 leader visited the local grammar school and observed a 90 minute mathematics lesson in which the teacher used only open-ended questions. This has led to further valuable discussion about the nature of questioning in lessons. At John Blow one of the teachers used an NCETM grant to develop a small scale collaborative project with a

colleague from another school which enabled them to spend valuable time in each other's classrooms. She found the reflection about her own teaching that this generated was a very positive learning experience for her.

The schools in the study all have strong subject leaders, but they value the high quality support from local authority advisory teams. Research indicates that extended CPD has significantly more impact than one-off training sessions, and the subject leader at St Philips has particularly valued the longer courses that she and her colleagues have benefited from in recent years. Opportunities for subject leaders to work outside their schools, as discussed earlier, add much to the expertise and confidence of subject leaders to provide high quality leadership within their own schools. As a leading mathematics teacher, the subject leader at St Peter and St Paul gets early training on new initiatives such as the Assessment of Pupil Progress (APP), and she values being in the vanguard of new thinking.



Embedding the Use and Application of mathematics



For many years the importance of children using and applying their mathematical skills has been highlighted in government documents and this has again been emphasised in The Primary Strategy. Subject leaders in the study schools are fully aware of the importance of embedding Using and Applying in the mathematics curriculum but recognise that the extent to which this is possible depends in large part on teachers' understanding and confidence. Moving from a position of 'We do problem solving on Friday' to embedding challenging mathematical thinking in every lesson and establishing high quality cross curricular planning which incorporates mathematics presents significant challenges, and the schools have adopted a wide range of approaches to help make this important transition.



A common strategy is to use a 'Maths Week' as a focus for developing a wider approach to problem solving and investigational work. Subject leaders are clear that it is essential to give colleagues appropriate support in order that the mathematical potential of such events can be maximised.

In a variation of this approach, staff at John Blow recently ran an Industry Week. This gave rich opportunities for relevant and motivating mathematics learning. Each class had to decide on a product that they would make and then sell at the end of the week and develop an appropriate business plan. A 'Dragon's Den' scenario was set up, with one of the school governors included on the panel. Children had to present their proposals in order to obtain seed funding. Local business people visited to talk to the children, including a representative from the Co-op to talk about Fair Trade. The mathematical potential was fully exploited, with staff becoming as competitive as the children about maximising profit. Staff here are particularly alert to developing the mathematical potential in all aspects of the life and work of the school, whether it is the children running their own bank on residential trips, or the mathematics of measurement, ratio and proportion and three dimensional shape involved in making Christmas cakes and decorative boxes.

St Philips, a city school, has a link with a school in a village some fifteen miles away. Having done a traffic survey in a nearby street, children shared their data with similar data from their partner school. They were surprised to find that the data they received showed a significant spike on one day of the week. This led to further investigation and enquiry before they worked out that the reason was that this day was market day in a nearby town. This gave the children an excellent opportunity to explore the data handling cycle in depth and to do this in a way they found highly relevant and motivating.

At St Peter and St Paul the subject leader has been developing the use of mathematics 'contexts' with her colleagues. These are based on ideas developed by the mathematics advisory team in Norfolk. A broad context for the term is established (for example Mathematics in Outer Space, The House Challenge). All the appropriate Primary Framework objectives for the term are then highlighted and outlines of appropriate problem solving and investigational activities are provided. Early feedback from children and staff is very positive.

Several of the schools consider that the implementation of APP should support the wider use of rich problem solving contexts, and they intend to do all they can to make this a reality as APP rolls out.

Perhaps one of the biggest challenges recognised in the study schools is developing investigational approaches to the teaching of core arithmetic skills, since this asks the most of teachers' own subject knowledge. The approaches described above help teachers develop in this area, but subject leaders acknowledge that more needs to be done here.



Engaging children in their own learning and personalised learning

Rich opportunities for using and applying are one way to increase the engagement of children in their mathematics learning and some examples are discussed in the preceding section. All the headteachers recognise that developing children's intrinsic motivation is a key to raising attainment significantly across the curriculum. Once again the schools are approaching this in imaginative and very different ways.

There is a growing body of research which indicates that the more children understand about learning, the more effective they can be as learners. At Hayes Park they are developing this by introducing the children to the 'five dispositions of lifelong learning', or the five R's, building on the work of educationalists such as Alistair Smith and Guy Claxton. These are about being resourceful, resilient, reflective, responsible and using reasoning. These are used alongside more curriculum focused success criteria to help children consider in what ways they have been effective learners during a lesson, and also are used to inform longer term individual learning targets. In a fast changing world, the school considers that these learning habits will be essential in the future lives of the children.

At Milton Hall many of the children live in very cramped accommodation with limited access to outside play areas. They therefore decided to make outside activities a particular feature of their recent Maths Week. Making large scale Venn diagrams on the playground, creating human graphs, acting out the 'Trolls Crossing the Bridge' investigation gave children excellent opportunities to work collaboratively, to persevere, to explore mathematical contexts where there is not a 'right answer' and to take responsibility for their learning. This had a positive knock-on effect on behaviour.

An approach used at Silsoe with Key Stage 2 children gives children the opportunity to make decisions about mathematics homework tasks. Children are given a pack of puzzles and problems copied onto different coloured paper to indicate challenge level. Simply by giving children this opportunity to choose their homework task has improved motivation.

At Fairstead staff have introduced what they call POTTI time each day – personal organisation time to improve. This is a time when children have the opportunity to follow up on, for example, comments and suggestions in their teacher's marking of their work. They are finding that many children want to come into class early each day in order to discuss their work further with their teacher, clear evidence that the children are responding positively to this.

Strategies which engage children in their learning contribute significantly to developing personalised learning. All the schools in the study have devoted much time and resource to this area of their work, using, for example intervention programmes from the Primary Strategy, curriculum targets, 1-1 pupil discussions, shared success criteria in lessons, meticulous tracking of pupil progress and so on.

At Fairstead, where raising attainment levels quickly has been important, the school has avoided the danger of intervention programmes fragmenting the learning for children by timetabling particular slots in the day when this work is done. The aim is that intervention work should be short term and effective and so the programmes are carefully and regularly monitored. The school has been trialling the Every Child Counts programme, run by an experienced part-time teacher. Initial indications are that this is proving to be very effective. Critical in this has been excellent liaison between the ECC teacher and the class teachers in order that the programme fits well with the mathematics being taught in the class, as well as the training of teaching assistants in the Every Child Counts approaches so that they can use these in their work supporting children in the classroom.

All the schools make use of curriculum targets with the children in order to help them understand the next steps in their learning and to give a clear underpinning to self and peer assessment. Most of the schools have reviewed their use of curriculum targets several times, as they have struggled to get the balance right between their impact on learning and their manageability. This has caused some frustration, and appears to be an area where further external support and advice would be welcomed. At St Philips a teacher who is particularly skilled at assessment has embedded APP securely in her mathematics planning and teaching and is finding that it is helping clarify next steps in learning, as well as highlighting areas where teacher subject knowledge is weaker. However, the school feels that there is still much to do at a national and local level to develop high quality moderation of mathematics assessment.

At John Blow teachers use assessment material from a published scheme at the start of a unit of work, not just at the end. In this way they are able to identify what the children still remember from the last time they covered the topic, and this then allows teachers to adjust planning so that their teaching is more focused on learning need.

But the schools all recognise that underpinning all of this is how well teachers know each child. In order to develop this at Milton Hall, dedicated liaison time between teachers and teaching assistants (TA) is built into the timetable so that the knowledge gained by TAs can be shared and given high status.

Class organisation



Larger schools have the option of teaching children in ability sets. The issues relating to the use of setting in primary schools are complex, and a number of research studies have investigated these. In general, the findings of this research are not well known in the study schools. The research tends to suggest that there is little measurable impact on learning arising from the use of ability sets. There is some indication from research that mixed ability teaching does not disadvantage higher achieving children, and positively advantages lower attaining children. Research findings also suggest that where setting is used, the methods used to determine who goes into which set have considerable margins of error. Issues of the possible negative impact on children's self esteem when put into ability sets need to be considered as part of decision making about class organisation.

The three larger schools in this study have all considered whether and how to use sets for mathematics and have each developed their own local and pragmatic approaches.

At Milton Hall children are taught in sets in Key Stage 2. Staff are very aware of potential self esteem issues and are expected to maintain high expectations of all children. The school has a large percentage of children for whom English is an additional language, and before they introduced setting they felt that fully mixed ability teaching in mathematics was detrimental to some of these children. However, one day each week sets are not used and this day is given over to more investigational work where children work in mixed ability pairs and groups, often using activities from NRich.

At Cottenham children in Key Stage 1 used to be taught in sets, but staff felt that this had little if any impact on attainment. Having abandoned setting in Key Stage 1 they have seen Year 2 results improve, and consider that this is a result of the mathematics work being better integrated into the wider curriculum and of the teacher having a more complete knowledge of each child's attainment across the curriculum. In Key Stage 2 they have maintained the use of sets, having, for example, two Y3 and two Y4 sets and then an additional smaller support group of Y3 and Y4 children with extra teaching assistant support. This inevitably creates timetabling constraints.

At Hayes Park they have adopted a flexible approach in Key Stage 2, recognising that the size of sets is usually determined by the pragmatic need for the sets to be sensible sizes, rather than on the children's real learning needs. Each year group is given the freedom to decide for itself what the best way of working with the children. Ability sets are used, but at times the year group works in mixed ability groups developing, for example, collaborative problem solving skills.

In one school where setting is used, there is a concern that the higher attaining sets are given more opportunities to develop problem solving and investigational approaches, while lower attaining sets focus too much on 'basic skills'. This has become a monitoring focus.

The headteacher at Fairstead has had a different issue to deal with. She inherited a school which was just under a one form entry. In order to respond effectively to the issues raised by Ofsted, she felt it important nevertheless to organise the school in single year groups, and has worked creatively in order to be able to budget for this.



Using ICT to support learning

All the schools in the study have a wide range of ICT resources to support learning. School networks are used very well by staff to share key documents, planning, assessment data and so on. As indicated elsewhere, most of the schools are at an early stage of developing virtual learning environments (VLE). But at Hayes Park there are some vibrant discussion rooms developing. One discussion thread among Year 4 children was about ways to help remember the 8 times table, and the vast majority of posts had clearly been made when children were at home. They had not reached a conclusion about the problem, despite seeking advice from older siblings, but the discussion showed how much they enjoyed using the VLE to discuss school work.

Teachers maintain a healthy scepticism with regard to ICT at times. Most of the study schools mentioned concerns that children should maintain rich hands-on, concrete experiences. Holding a cube in your hands cannot be replaced by only looking at an image of a cube on a screen. In one school monitoring of teaching led to the realisation that the interactive whiteboard was being over-used as a display for PowerPoint type teaching presentations, and this was leading to too much didactic teaching from the front. In response to this they have encouraged more interactive teaching styles.

Attitudes to the interactive teaching programs (ITP) available from the Primary Strategy website vary considerably. In some schools teachers have developed understanding of how these can be used powerfully to encourage deeper mathematical thinking, and they quite like the plain appearance on screen. They recognise that identifying ways to make best use of them takes time and thought. In other schools there is resistance arising from the unsophisticated visual look of the programs, and staff prefer more attractive software, even if it might not have as much potential for rich learning, for example software that has more of a focus on skills practice. At St Peter and St Paul, the subject leader likes wherever possible to use an ITP as part of plenary sessions when she teaches older children, as she feels that this encourages the children to develop more abstract thinking at an appropriate stage in the lesson.

The schools all recognise the potential of ICT to enhance the mathematical focus in cross curricular work, for example, by using spreadsheets to organise and analyse data in practical science work. A teacher of older children at John Blow makes creative use of Google Earth as part of their geography work, making excellent use of this for developing mathematical skills relating to measures and time. But most of the schools recognise that this an area that they would like to develop in, and that this in turn will depend on staff knowledge and confidence.

Working with parents

All the headteachers have put much energy into developing links with parents, recognising in particular that mathematics is an area where many parents themselves feel they have poor skills and find calculation methods espoused by the Primary Strategy to be unfamiliar. 'It's not how I learnt it at school' is a constant refrain from parents. The schools also find that it is an area of the curriculum where it is not uncommon for negative attitudes to be passed from parents to children. Unsurprisingly, the schools serving areas of higher social deprivation tend to find engaging parents more of a challenge.

All the schools have organised sessions for parents to come into school where 'modern methods' can be explained and discussed (often supported by high quality input from local authority advisory teachers), and many of the schools have put together information booklets to go home. Headteachers often wonder how much impact these have, and certainly tend to feel that the parents who come to such meetings are not always the ones who the schools most need to develop stronger links with.

Milton Hall has had success with parents of younger children by running sessions first thing in the morning, straight after the parents have dropped their children off at school. They call these sessions 'Play and Stay'. Schools have found that parents appreciate the opportunity to sit in one of their children's maths lessons, finding this a particularly valuable experience. At Fairstead the headteacher recognises that developing the confidence of many of the parents so that they can take a more active part in their children's learning is a longer term project. She entices parents in with coffees and cake, spends a little time in classrooms, then perhaps does an activity with the parents such as a mathematics Bingo game. Parents and grandparents respond well to requests to help after school with projects such as the vegetable garden and wildlife garden, and from these the headteacher hopes that it will be possible slowly to develop greater engagement with core curriculum areas.

Cottenham's catchment includes a sizable Traveller community, and this brings a different range of issues relating to communication and attendance. The headteacher has recently appointed a teaching assistant who has specific responsibility for developing links with these families and who is a regular visitor to the Traveller site. They are experimenting with, for example, recording school newsletters onto iPods for the families.



Virtual learning environments have the potential to develop strong links between school and home (provided of course that families have computers and internet access). The schools in this study are mostly at very early stages of developing this capacity and recognise that this is an area where further support would be welcomed. In part this is about helping them develop a clear vision for their use. The schools currently make relatively little use of their websites to communicate aims and methods in mathematics. Hayes Park is a school that has moved further than most and is developing a vibrant VLE which children (and hence their parents) can access at home. One of its uses is to upload homework tasks, along with notes for parents about the activity's rationale. This helps communicate the thinking behind tasks that are richer than low level skills practice worksheets.



The schools recognise that homework tasks are one way of communicating key messages about the curriculum. At Silsoe mathematics homework has been changed from what had previously been a worksheet dominated activity. In Key Stage 1 a set of practical games and activities is sent home at the start of each term, with guidance for parents. Parents are encouraged to decide for themselves which activities to use each week. At first the school encountered some resistance to this, but through consistent discussion and communication with parents this has now dissipated and has become embedded in the life of the school.

Next Steps

The NCETM will:

- ensure that the good practice and expertise described in these case studies is disseminated nationally through the NCETM networks and portal and through appropriate partners;
- engage with key groups in school leadership, such as the National College of School Leadership, to take forward the messages to other headteachers and to aspiring headteachers;
- develop further links with senior school leadership, encouraging discussion and development of strategies for creating and sustaining a good mathematics department or workforce;
- continue to support ITT students, especially by providing easy access to high quality resources that support teaching and learning in mathematics;
- ensure that teachers of mathematics continue to have access to information on, and encouragement to participate in, a range of models of professional development that includes those with a focus that extends beyond a school's immediate concerns;
- continue to develop local networks of practising teachers so that they feel both supported and challenged and have access to the many new resources which promote good mathematics teaching; We hope that other agencies will also take forward the important messages of this report and support headteachers in developing a vision for mathematics and an environment that nurtures the development of teachers of mathematics.

Appendix 1 Participating Schools

Participating Schools and staff who participated in this case study

Cottenham Primary School, Cambridgeshire

Cottenham Primary School is a very large school serving the village of Cottenham on the edge of the Fens. The percentage of pupils who have learning difficulties is below average, as is the percentage entitled to claim free school meals. There is a growing Irish traveller population.

Headteacher: Jan Wright
Deputy Headteacher: James Kilsby

Fairstead Primary School, King's Lynn, Norfolk

Fairstead Primary School is a larger than average primary school serving an area of significant deprivation. Attainment of the children when they start at the school is well below the national average. The majority of pupils are from White British heritage.

Headteacher: Suzanne O'Connor
Subject leader: Jo Niven

Hayes Park Primary School, Hillingdon

Hayes Park Primary School is a very large primary school in the London borough of Hillingdon. Just under half the pupils are from a wide range of minority ethnic heritages, a quarter of pupils are bilingual and around one in ten of pupils are at the early stages of learning English as an additional language.

Co-headteacher: Deb Barlow
Subject leader: Liz Rhodes

John Blows Primary School, Collingham, Nottinghamshire

John Blows Primary School is a smaller than average school in the village of Collingham on the Nottinghamshire border with Lincolnshire. It has a socially and economically mixed intake, the majority of whom are White British.

Headteacher: Helen Richardson

Milton Hall Primary School, Southend

Milton Hall Primary School is a very large primary school in Southend. Pupils come from a wide range of backgrounds. Over a third come from minority ethnic backgrounds, and almost all of these have English as an additional language. An increasing number of homeless families, many of whom are new to this country, are initially housed in the area, and subsequently re-housed elsewhere.

Headteacher: Margaret Haynes
Subject leaders: Rhian Ager and Andrew Smith

St Peter and St Paul Primary School, Carbrooke, Norfolk

St Peter and St Paul is a small village primary school serving a mixed catchment area. Most pupils start at the school with levels of knowledge and understanding that are below those expected nationally.

Subject leader: Rosie Newport

St Philip's Primary School, Cambridge

St Philip's Primary School is a medium sized primary school serving a diverse community. The percentage of pupils entitled to free school meals, the proportion identified as having learning difficulties the number of pupils from minority ethnic groups and those who speak English as an additional language are all above national averages.

Headteacher: Soibhan Rouse
Subject leader: Ann Chappell

Silsoe Lower School

Silsoe Lower School is a small village school taking children up to Year 4. Most children are from White British backgrounds and a small proportion have English as an additional language. The proportion of pupils with statements of special educational needs is very high.

Headteacher: Susan Purdue
Subject leader: Beth Richardson

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A Department for Children, Schools and Families initiative to enhance professional development across mathematics teaching.