



Fair
Education
Alliance



Closing the attainment gap in maths: a study of good practice in early years and primary settings

Dr Catherine Knowles
Achievement for All



Acknowledgements

The Fair Education Alliance would like to thank the following primary schools and early years settings that contributed to this report, particularly for their time in sharing their innovative and effective practices and approaches to mathematics: Belfield Community School, Rochdale; Elmhurst Primary School, Newham, London; Grafton Primary School, Islington, London; Parkfield Community School, Birmingham; Pound Hill Junior School, Crawley; Hillside Avenue Primary and Nursery School, Thorpe St Andrew, Norfolk; Hillmorton Primary School, Hillmorton, Rugby, Warwickshire; John Scurr, Stepney Green, London (Tower Hamlets); Victoria Lane Academy, Coundon, Durham; Wroxall Primary School, Isle of Wight; Torpoint Nursery and Infant School, Cornwall; Redcliffe Nursery School and Children's Centre, Redcliffe, Bristol; Thames Children's Centre, Blackpool; Bottesford Bunnies Pre-School, Scunthorpe, North Lincs.; Flutterbies Nursery, Rotherham; Little Owls Nursery, Scunthorpe, North Lincs.; Amanda King, Childminder, Mitchell, Newquay, Cornwall (Lollipops Childcare); Carolyn Ince, Childminder, Buckinghamshire; Charlotte Greeno, Childminder, Cambridge (city) and Sue Smith, Childminder, Ely.

We also thank those who contributed ideas through our website (<http://www.faireducation.org.uk>), along with our members, other organisations engaged in mathematics education and government backed organisations. And thank you to Dr Alison Borthwick of the Association of Teachers of Mathematics for her insights into primary and early years maths teaching and learning.

FEA Primary Mathematics Working Group

Co-chairs: Catherine Knowles, Achievement for All and Corrine Harms, KPMG.

Members; Liz Bayram, PACEY; Helen Drury, Mathematics Mastery; Susannah Hardyman, Action Tutoring; Colin Hegarty, Hegarty Maths; Jeremy Hodgen, University of Nottingham; Wendy Jones, National Numeracy; Ems Lord, NRICH; Lynne McClure, Cambridge Maths; Bruno Reddy, Mr Reddy Maths; Lucy Rycroft-Smith, Cambridge Maths.

FEA

Sir Richard Lambert, FEA Chair
Dame Julia Cleverdon, FEA Vice Chair
Lewis Iwu, FEA Director
Alex Turner, FEA Coordinator

Foreword

Failure to grasp basic numeracy skills remains a persistent problem in the UK, and one that is worsening in our poorest communities. Shockingly, the 2016 OECD rankings show that a gap equivalent to about eight years of schooling exists between the highest and lowest performing students in England. This has serious repercussions later in life: students who fall behind stay behind, and weak maths skills can limit life chances, leading to poor outcomes such as school exclusion, unemployment, and involvement with the criminal justice system.

However, educational inequality is not inevitable. Exemplary schools, like those featured in this report, are supporting children to thrive in maths and give them the building blocks they need to succeed in life. But unfortunately these schools remain the exception rather than the rule.

Closing the numeracy attainment gap is an ambitious goal and requires tactical and decisive actions that can accelerate the rate of change. This report does both of those things: it provides practitioners with clear best practice examples that they can apply to their own primary school or early years setting. It also provides policymakers with a strategic blueprint for change, providing guidance on approaches that can be scaled up.

The UK remains one of the least socially mobile economies in the developed world. As a nation, we are failing to make the most of the talent on offer to us. At KPMG we recognise this, not just as a matter of fairness and equality of opportunity, but as a clear economic imperative. Indeed, social mobility is not only the golden thread that runs through almost all of our corporate responsibility programmes, it is also a key tenet of our commercial strategy, influencing how we organise ourselves and recruit talented people to our firm.

That is why we are committed to working with fellow members of the Fair Education Alliance, to effect real and lasting change in the area of numeracy teaching. The recommendations in this report need to be penetrated deep into schools and amplified to policymakers. There is much to do to ensure that everyone is granted the opportunity to reach their full potential, regardless of their socio-economic background.

Simon Collins
Chairman, KPMG UK

Contents

Executive Summary	5
Introduction	8
How to develop good practice maths in your primary school	11
Primary School case studies	
Belfield Community School, Rochdale	13
Elmhurst Primary School, Newham, London	16
Grafton Primary School, Islington, London	19
Parkfield Community School, Birmingham	22
Pound Hill Junior School, Crawley	25
Hillside Avenue Primary and Nursery School, Thorpe St Andrew, Norfolk	29
Hillmorton Primary School, Hillmorton, Rugby, Warwickshire	32
John Scurr, Stepney Green, London (Tower Hamlets)	34
Victoria Lane Academy, Coundon, Durham	37
Wroxall Primary School, Isle of Wight	40
Summary: Primary Schools	43
How to develop good practice maths in your early years setting	46
Early Years case studies	
Schools:	
Torpoint Nursery and Infant school, Cornwall	48
Children's Centres:	
Redcliffe Nursery School and Children's Centre, Redcliffe, Bristol	52
Thames Children's Centre, Blackpool	56
Nurseries:	
Bottesford Bunnies Pre-School, Scunthorpe, North Lincs.	59
Flutterbies Nursery, Rotherham	63
Little Owls Nursery, Scunthorpe, North Lincs.	66
Childminders:	
Amanda King, Childminder, Mitchell, Newquay, Cornwall (Lollipops Childcare)	69
Carolyn Ince, Childminder, Buckinghamshire	71
Charlotte Greeno, Childminder, Cambridge (city)	74
Sue Smith, Childminder, Ely	77
Summary: Early Years settings	79
Conclusion	82
Recommendations	83
Abbreviations	84
Glossary	84
References	89
Appendices	90

Executive Summary

Findings show that when primary schools and early years settings have a whole school or setting approach to maths, children's outcomes are better and in many cases exceed expectation. A whole school approach means focusing on maths across leadership, attitudes (children, teachers, practitioners, teaching assistants, parents), teaching and learning, progress and assessment, the environment, parent and carer engagement, wider opportunities and well-being.

Children from socio-economic disadvantage are more likely to underachieve in maths throughout their school career than their more advantaged peers. In 2016 just over half of all children from disadvantaged families achieved the expected level in maths at age 11 (58%). This compared to their more advantaged peers where 76% achieved the expected level (DfE, 2016). This means that a significant proportion of children from disadvantaged families leave primary school without the basic maths skills to succeed at secondary school; strong maths skills and understanding at age 11 provide a firm base for success during secondary education and beyond.

This report follows on from the FEA Report Card 2015 (FEA 2016) which showed that in some areas children are better served by some schools than others. Although family background has a significant impact on children's achievement in England, the case studies in this report show that with a whole school or setting approach to maths, the link between underachievement and socio-economic disadvantage can be broken. The schools and early years settings that are getting it right, as shown by these case studies, are delivering a high quality education irrespective of children's social or economic background. This report not only provides teachers and practitioners with examples of best practice which can be applied in classrooms and early years settings, it provides a strategic plan for policy makers on approaches to maths which can be scaled up.

The best practice examples in this report have been identified through data and qualitative research. The case studies which follow can inform teaching and learning in the sector as it strives to close the attainment gap in maths and equip children and young people with the maths skills and knowledge they need to succeed in school and beyond. Best practice in maths can close the gap.

This report aims to bring together some examples of good practice in maths teaching and learning in early years settings and primary schools that are successfully closing the attainment gap in children's maths attainment. It includes examples from education settings in some of the most deprived neighbourhoods of England as well as those in more affluent areas that are doing particularly well for their disadvantaged children; these latter schools have used pupil premium funding effectively. At the same time, it includes early years settings and primary schools that, although not necessarily closing the attainment gap for their disadvantaged children, are successfully 'turning maths around' and bringing all children with them.

In the final instance, 10 primary schools were identified, along with 10 early years settings. Primary schools in deprived neighbourhoods (DfE, 2015) were initially identified through value-added mathematics scores from national datasets. Further primary schools and early years settings were identified by and through Alliance members, a strong coalition of over 72 UK organisations committed to educational change.

Primary schools that are closing the maths attainment gap are:

- Changing attitudes; negative attitudes to maths amongst staff, children and their parents are not tolerated
- Developing number and number sense in lessons; in some schools 75 % of maths lessons are devoted to numbers
- Ensuring those likely to underachieve are exposed to the same rich maths experiences as their peers
- Focusing on children spending a short time with a teacher before the lesson to go over a concept they failed to grasp in the previous lesson
- Engaging parents in the process; they arrange workshops to help parents support their child's maths learning both at school and at home.
- Providing focused teacher continuing professional development (CPD)
- Raising the profile of maths, with opportunities for maths across subjects purposefully identified
- Displaying mathematical problems, language and calculations on classroom walls and in corridors
- Providing 'maths week' and/or 'enterprise week' across the school to develop maths skills and financial literacy
- Moving away from the idea of accelerated progress to the development of mathematical language and conceptual understanding; maths is frequently set within a real life context
- Starting lessons with a 'problem' and providing regular maths competitions across the school
- Often building on these foundations by adopting the mastery approach to teaching maths or aspects of it, based on that used in Singapore and Shanghai. Encompassing three core elements - deep understanding (often accompanied by the concrete, pictorial, abstract approach), problem solving and success for all (high expectations). There is a focus on whole class teaching

Early years settings in England that are closing the maths attainment gap are:

- Developing strong leadership of maths; leaders with a good knowledge and understanding of maths and maths teaching and learning
- Raising the profile of maths by bringing it into all activities
- Adapting the environment to focus on numeracy
- Developing the concept of 'number'; children understand the concept of 'fourness' by the time they move on to school
- Building practitioner confidence and skills through focused CPD; enhanced through action research/individual projects
- Providing time for staff to plan together
- Giving children immediate feedback
- Teaching maths through a 'real-life' context, developed through theme work and games
- Engaging children in maths problem solving or enquiry as soon as they arrive in the mornings
- Talking to and listening to children, which enables them to know the children better - their strengths, areas for development and the things they enjoy
- Closely monitoring and assessing children

We hope that other early years settings and primary schools will use the best practice identified in this report to improve their own position.

Putting it into practice

The value of these case studies lies in the extent to which the practices and approaches to maths can be replicated and/or adapted by other early years settings or primary schools. For primary schools there needs to be a focus on leadership of maths, teaching and learning, parent and carer engagement and provision of extra-curricular or wider opportunities. For early years settings there needs to be a focus on leadership and management, the learning environment, collaborative working within the setting and with parents and carers and on children's progress and learning.

Recommendations

For too many children and young people, the pattern of underachievement in maths has not yet been broken. There is still a lot more work to be done in early years settings and schools across England.

Based on these case studies, we present the following recommendations that, if implemented, could help to improve maths outcomes for all children and across all early years and primary settings in England:

A national maths professional development programme (subject knowledge and pedagogy) for early years settings, which includes better support for practitioners in assessing and supporting children's progress in maths.

Data recording - we propose that the current Ofsted inspection framework is changed so it looks for greater evidence of how well early years settings are supporting children's early maths development.

Parental engagement, evidence shows the centrality of parent engagement for better outcomes in children's short and long term learning and development. All early years settings and primary schools should have focused approaches to developing this further.

Transition - continuity in approaches to maths to support children's understanding and further development. There needs to be a focus on continuity in approach and practice from early years to primary school and primary to secondary school and beyond.

Action research/ individual research projects - focused teacher/practitioner continuing professional development (CPD) builds teacher and practitioner skills and confidence in teaching maths. They become confident in performance and attitude. This is further developed through action research in schools and early years settings or teacher/practitioner individual projects.

Introduction

Since 2006, 15 year olds in England have fared badly in the PISA maths rankings in comparison to their peers across many of the other OECD countries and economies. Perhaps what is more disconcerting, highlighted by this year's results, is the very big gap between the highest and lowest performing students in England, equivalent to about eight years of schooling and one of the biggest across OECD countries (Jerrim and Shure, 2016). In addition, the maths scores of those in the lowest performing group in England are worse than in many Western countries. Family background still has a significant impact on student achievement in this country, with big achievement gaps between young people from poor families and their more advantaged peers. These young people will have spent the same amount of time in maths classes as their more advantaged peers and in some cases more (OECD, 2016a), but because of ability setting, a system widely used in England for maths (less frequently for other subjects), they will have had less exposure to core mathematical concepts - equations or functions for example - than their more advantaged peers. This can put them as much as two years behind other children who have spent their maths lessons figuring out the concepts of algebra or geometry (OECD, 2016b). Other research highlights the importance of exposure to pure maths in building resilience, where resilient pupils tend to perform better overall in maths (Wheater et.al., 2016). They further showed that self-confidence in maths had the strongest association with resilience, where confident children from less advantaged families were also likely to be high achievers in maths (Wheater et al., 2016: 23).

Children begin school at the age of four or five with considerable differences in maths skills and understanding; some primary schools in some areas of England address this well. Children tend to perform better at maths in primary school than they do during their secondary education (DfE, 2016). Nonetheless, the gap in maths performance at age 11 between children from poor families and their more advantaged peers still exists and widens significantly during secondary school. This can have longer term repercussions; achieving maths GCSE at grade A*-C provides a strong base for success in life (Hayward et al., 2014). Other research shows that attaining higher maths test scores at age 10 leads to higher earnings in adulthood, over and above the qualifications young people go on to achieve (Conlon and Patrignani, 2015).

- These differences will continue to grow over children's school careers if maths teaching and learning in the earliest years of education are not re-evaluated across England; strong maths skills and understanding at age 11 provides a firm base for success during secondary education. This report follows on from the Fair Education Alliance Report Card 2015 (FEA 2016) which showed that in some areas children are better served by some schools than others; in these schools and early years settings, they are delivering a high quality maths education irrespective of children's social or economic background. With good maths opportunities and teaching in early years education and primary school, children's achievement and enjoyment of maths is raised.

The current report, building on the Report Card 2015 (FEA, 2016) brings together examples of primary schools and early years settings across England that are getting it right in maths teaching and learning. They are providing a whole school approach to maths for all children (PwC, 2016); this approach encompasses leadership, attitudes, teaching and learning, progress and assessment, the environment, parent and carer engagement, wider opportunities and well-being. In these settings children's outcomes in maths are good or getting better. A clear theme emerging from this is the centrality of positive attitudes and a 'can do' mentality in driving improvement and enjoyment in maths, purposefully identified as an area for change in many of the schools and settings. The impact on teacher and practitioner performance of negative attitudes to maths is acknowledged in the wider literature, which leads to disengagement, a lack of confidence and an unwillingness amongst children and young people to improve maths skills (National Numeracy, 2015). The case studies in this report are not the only examples of good practice but rather are intended as examples of a whole school or setting approach making maths accessible to all children. They show what educational

settings are doing to drive improvements in children's outcomes in maths in some of the poorest areas of England or for children from economically disadvantaged families.

Primary schools in England that are getting it right are focusing on children spending a short time with a teacher before the lesson to go over a concept they failed to grasp in the previous lesson. These schools ensure that children likely to underachieve are exposed to the same rich maths experiences as their peers. Negative attitudes to maths - amongst staff, children and their parents - are discouraged and the development of number and number sense is central to lessons; in some schools 75 % of maths lessons are devoted to number work. Focused teacher CPD is a central characteristic.

In the best of these schools, the profile of maths has been raised, with opportunities for maths across subjects purposefully identified. Mathematical problems, language and calculations are displayed on classroom walls and in corridors, with 'maths week' and 'enterprise week' introduced to develop maths skills and financial literacy.

The focus on depth in the new primary maths curriculum (DfE, 2014) is enabling many schools to move away from the idea of accelerated progress to the development of mathematical language and conceptual understanding; maths is frequently set within a real life context. Lessons start with a 'problem' and regular maths competitions across the school make it engaging; the result is that primary school children in England are enjoying maths. These schools also see the importance of engaging parents in the process; they arrange workshops to help parents support their child's maths learning both at school and at home. For children from economically disadvantaged families this can have a significant impact on their outcomes (National Numeracy, 2016; PwC, 2016).

A number of primary schools in England are building on these foundations by adopting the mastery approach to teaching maths or aspects of it, based on that used in Singapore and Shanghai. Encompassing three core elements - deep understanding (often accompanied by the concrete, pictorial, abstract approach), problem solving and success for all (high expectations), there is a focus on whole class teaching. All children have the opportunity for rich maths experiences.

Early years settings in England, that are closing the maths attainment gap for their disadvantaged children highlight the importance of raising the profile of maths, including bringing it into all activities, adapting the environment to focus on numeracy and building practitioner confidence through focused CPD.

The lack of an overly prescriptive EYFS (early years foundation stage) framework provides many opportunities for developing maths at setting level. Knowing each child - their strengths, areas for development and the things they enjoy is a common theme; close monitoring and assessment characterise settings where children do well in maths. Numbers and developing the concept of 'number' is important in these settings; children understand the concept of fourness by the time they move to school.

For too many children and young people, the pattern of underachievement in maths has not yet been broken; many children from less advantaged families are not accessing the whole school or setting approach to maths outlined in this report. There are significant challenges ahead, the benefits of which may not be realised for some time in England. But there is still a lot more work which can be done by early years settings and schools in enabling all children, particularly those from less advantaged families, to access a whole approach to maths.

Based on these case studies that follow, we present a number of recommendations that, if implemented, could help to improve maths outcomes for all children across all early years and primary settings. These are:

A national maths professional development programme (subject knowledge and pedagogy) for early years settings, which includes better support for practitioners in assessing and supporting children's progress in maths.

Data recording, we propose that the current Ofsted inspection framework is changed so it looks for greater evidence of how well settings are supporting children's early maths development.

Parental engagement, evidence shows the centrality of parent engagement for better outcomes in children's short and long term learning and development. All early years settings and primary schools should have focused approaches to developing this further.

Transition - continuity in approaches to maths to support children's understanding and further development. There needs to be a focus on continuity in approach and practice from early years to primary school and primary to secondary school and beyond.

Action research/individual research projects - focused teacher/practitioner CPD builds teacher and practitioner skills and confidence in teaching maths. They become confident in performance and attitude. This is further developed through action research in schools and early years settings or teacher/practitioner individual projects.

How to develop good practice maths in your primary school

The value of these case studies lies in the extent to which the practices and approaches to maths can be replicated and/or adapted by other early years settings or primary schools. Figures 1-5 below show the key areas of focus in primary schools for developing a whole approach to maths. These are leadership, teaching and learning, planning and assessment, wider opportunities and parent engagement. Each figure shows six clear points, informed by the case studies, for developing a whole approach to maths across a particular area. These figures can be used as a professional development tool to support the development of a whole approach to maths. For each point mentioned in the circles, it will be helpful to consider if you do this in your school, how you do it and as you read the case studies which follow, if you could do it better.



Figure 1: Leadership

Figure 2: Teaching and Learning



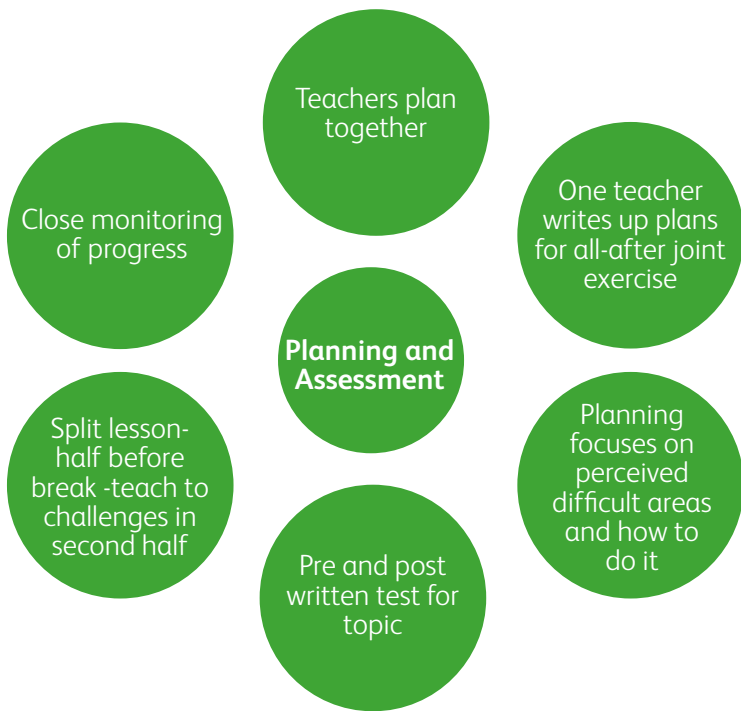


Figure 3: Planning and Assessment

Figure 4: Wider opportunities for maths

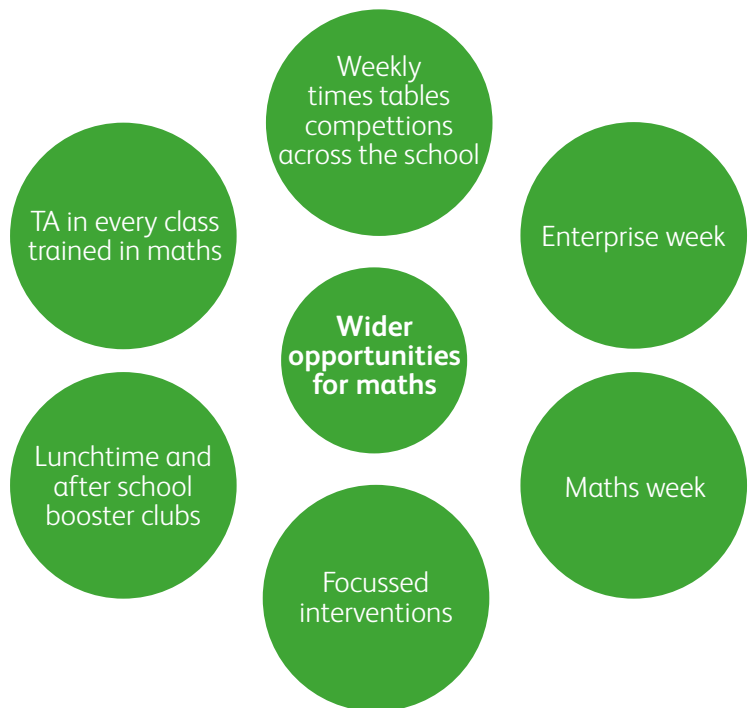
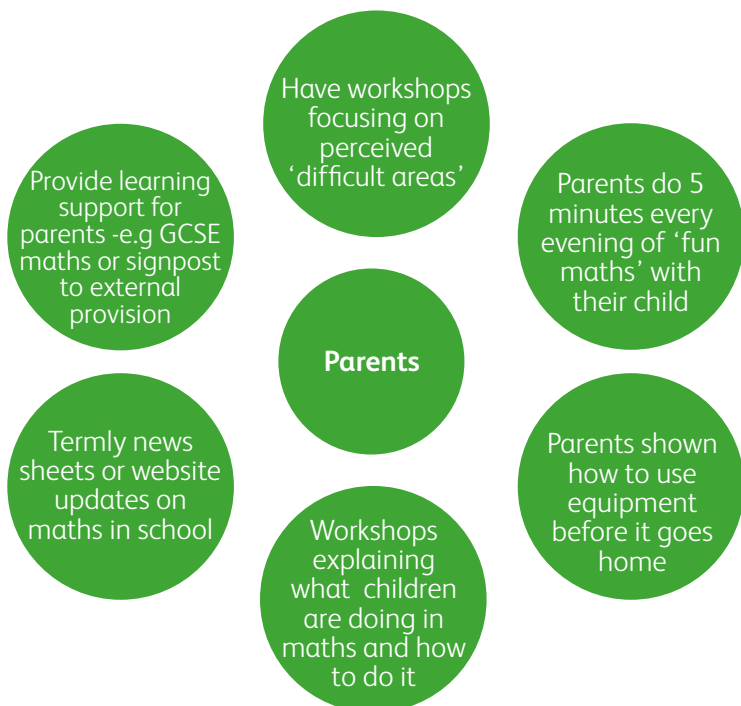


Figure 5: Parents



Primary School Case Studies

Belfield Community School, Rochdale

Why children at Belfield Community School do well in maths; Key statement from the head teacher:

“Many children come with a low starting point and we focus on the essentials for maths and consistency in approach - the same maths learning wall in every classroom; a focus on learning powers (i.e. what it takes to be a good learner). We teach the children to learn from mistakes and move on; it can be good to make mistakes. And, we are constantly asking children to consider numbers, for example 365; how many ways can you get to 365?”

Key school data

(2015)

340 pupils age 3-11 years

38% of pupils are Pupil Premium (national average: 26 %)

80% of pupils are EAL (national average: 19 %)

Key performance data

When the current head teacher took over eight years ago only 43 % of pupils achieved the expected level at the end of KS2. In 2015, 87 % of pupils achieved L4+ in maths with 38 % achieving L5; 82 % of disadvantaged children reached this level.

Context

Belfield, situated in one of the 10 % most deprived areas of the country, has a higher than average number pupils who are eligible for pupil premium funding and a high proportion of children whose first language is not English. Changes to maths were made eight years ago when the head teacher joined the school. She had worked for National Strategies and brought a lot of new ideas to the school. Belfield works in collaboration with 10 other schools, which are part of the IPLCN (Inspirational Professional Learning Community Network). The school links with these other schools and has a comprehensive diary of support and challenge, including programmes for NQTs and RQTs (recently qualified teachers), moderation of standards and sharing good practice.

.....

Approach: general

One of the first initiatives included the introduction of the maths passports, with a focus on calculations. Children’s achievements are recorded in their passport, enabling teachers to quickly identify any gaps in their learning. The team leader has a very good overview of children’s progression.

Every classroom has a maths working wall, with key language and phrases, along with ‘real-life’ maths problems or situations. Trimmed with a blue border (red for literacy), this brings consistency across the school, consistency in language and methods, as well as improving and enhancing teacher subject knowledge.

Maths is found in all subjects across the school; initial planning, which staff do together, highlights possible areas where maths can be brought in. Examples include timelines in history, scales and data in science, along with classification of materials. Every year there is an ‘enterprise week’, where children are given a sum of money and have to work out how much it will cost to produce the goods, the selling price and the profit margin. An annual maths themed week is also on the wider curriculum.

Content and approach

For all children there is a big focus on number and calculation, which the EAL children pick up very quickly. Times tables are essential and children take part in rapid recall competitions with teachers.

The whole class approach to teaching with differentiation included, is supported by children working through the school’s own maths work scheme; children know their targets. When they grasp the concept, they move on and teachers spend time during the lessons supporting other children who have not yet ‘got there’; for reasoning and problem solving children can be grouped by ability. Children’s work is monitored by the senior leadership team according to a robust monitoring plan. They regularly visit classes and look at children’s books.

Metacognition, initially developed through Numbers Count, means that all children from nursery through to Year 6 can explain to each other how they arrived at the answer.

Interventions

Belfield introduced the Every Child Counts maths programmes about five years ago. These include Numbers Count, where a specially trained Numbers Count teacher works with children individually or in twos or threes. After a detailed diagnostic assessment, the teacher plans a tailored programme for each child. Rigorous, active lessons focus on number and calculation, helping learners to develop skills and attitudes that will ensure good progress in class lessons. The teacher shares strategies with teachers across the school helping to raise standards for all learners. They also include **Success@Arithmetic** and **1stClass@Number** which are delivered in small groups by specially trained teaching assistants. The key feature of the interventions is the way they enable the school to monitor a supportive culture for both children and staff; the interventions have made a big difference to the children.

There is a focused approach to interventions, which are used to build on areas of strength in a child’s maths, helping them to overcome difficulties and develop positive attitudes to learning. Taught by both teachers and teaching assistants, trained in the intervention, a child identified for an intervention may have 20 minutes extra teaching three times a week. Parents whose children participate in Numbers Count come in to observe the lesson and borrow Numbers Count bags from the school, to support their child’s learning at home.

Training

Teacher CPD is a big focus and the school uses the lesson study approach on an ongoing and frequent basis. Staff are trained in how to use maths resources effectively and attribute pupil success in maths to both learning the method and knowing how to use the equipment. A specialist maths teacher is employed for higher ability children.

Parent engagement/home learning

The senior leadership team introduced 'drop-in' sessions for parents to watch their child being taught maths; many do not speak English. In addition, there are termly sessions on 'how to help your child with maths'. The school's message is clear: 'maths is in every-day life and is linked to almost everything we do'.

Homework focuses on times tables and number bonds. Parents are encouraged to support their children with this. Equipment can be sent home for children to use, with parents invited in to the school to learn how to use it.

Improving children's outcomes in maths: Key to success

- A focus on core numbers and calculation.
- Consistency in approach - the same maths learning wall in every classroom.
- A focus on learning powers: what does it take to be a good learner?

Looking to the future

- A stronger focus on calculation - as the head teacher says '**if children are not strong in calculation, they cannot move on**'.
- Deeper learning in children's reasoning.
- Greater support for development of teacher subject knowledge - staff training is structured on 'a problem' they bring to the meeting and the team work through it together.

Elmhurst Primary School, Newham, London

Why children at Elmhurst Primary School do well in maths: Key statement from the assistant head teacher and head of the Maths Hub (The London North East Mathematics Hub):

“When we changed to mixed ability groups and introduced the Singapore approach we found that children who were slower learners are being exposed to richer maths; in essence the slower learners are learning more. The government has said that ‘we all move together’ - so all children are taught using the same materials. That is the overarching focus - so everything relating to maths teaching and learning fits into that. And with the ‘new’ approach teacher expectations for children’s learning and outcomes have been raised.”

Key school data

(2015)

988 pupils age 4-11 years

35% of pupils are Pupil Premium (national average: 26 %)

96% of pupils are EAL (national average: 19 %)

5% of pupils are SEN with support (national: 12 %)

Key performance data

In 2013, 89 % of pupils achieved Level 4 or above at KS2 maths; 97 % of disadvantaged pupils made the expected progress between KS1 and KS2; this compared with a 100 % of other pupils.

In 2014, the schools results in maths were in the top 20 % of similar schools and the top 40 % of all schools nationally.

In 2015, 94 % of pupils achieved ‘At Standard’, with 35 % achieving ‘Greater Depth’.

Context

In 2014, Elmhurst Primary School in Forest Gate became **one of six Maths Hubs led by a primary school**; 2016/2017 will be the beginning of the third year for the school. As the lead school, selected for its history of high quality maths teaching, Elmhurst has responsibility for sharing good practice across primary schools in the seven boroughs of Newham, Barking and Dagenham, Redbridge, Waltham Forest, Tower Hamlets, Hackney, and Havering. The National Maths Hubs meet three times a year for a two-day forum. These look at everything relating to maths (teaching, learning and national and international changes/research); these sessions, which provide focused CPD, guide the work of each Hub. Through the Hub, Elmhurst is also involved in an **Action Research Project**, focussed on lesson study and ‘unpicking’ best practice. This is further supported through the structure of the Hub, which has four mastery specialists, across the schools; for the Action Research Project, the Hub meets half termly and studies a lesson.

Being the lead school in the Maths Hub, the assistant head believes Elmhurst has learned a lot from the

exchanges with teachers in both Singapore and Shanghai, particularly when they have visited the school in England - 'watching them teach and the training they have done with us has been good'.

This case study focuses on the changes the maths lead made across the school to further enhance children's outcomes.



Approach: general

The first change was moving from ability group to whole class teaching in KS1 and partially in KS2; grouping was working at KS2, so the school decided to keep it. But for children at KS1, ability grouping was not working; the achievement gap was not closing. Training teachers and teaching assistants has been a strong contributory factor to the schools' success. At both KS1 and KS2, all classes have a class teacher and a teaching assistant. Both have training in the **Singapore mastery approach** by the head and deputy heads of maths; and key teachers within the school have been out to Singapore and Shanghai to see it first-hand.

Content and approach

Maths teaching is based on the Singapore mastery approach, which is similar to the Shanghai approach. The school adopted the Singaporean textbook - Maths-No Problem! Teachers use the textbook every lesson. Sometimes they will take examples from the book and put it on the whiteboard. Other times the books will be given to the children for them to work through examples; children do not have their own copy. Maths -No Problem! is very much in keeping with the National Curriculum.

The assistant head believes children learn maths this way because it is based on a staged process (small steps) - concrete, pictorial and abstract; **for example, concrete (real objects - beads for young children; pictorial a picture and then numbers).** About 70% of teaching time is spent on numbers. The Singapore approach has less content, so there is less focus on geometry and statistics.

To accommodate the mastery approach, the school changed the way it approached planning. For every lesson teachers are now asked to think in advance of where the difficulty points are for pupils and how they would address them. One teacher writes it up; this provides the lesson outline for all teachers. This process is repeated about every four weeks.

Two- tiered approach to interventions

Same day intervention -if a teacher identifies one or more children who have not grasped a particular concept during the lesson, he/she will spend 10-15 minutes at the beginning of the following lesson going over the concepts with the children. As each class has a teaching assistant (TA), the TA will take the rest of the class during this period. In England, unlike Singapore, there is no teacher protected time to do this type of small group or one to one teaching outside of class time.

Year group interventions for identified children - Elmhurst is currently trialling Numbers Count for one year group and 1stClass@Number with another year group. 1stClass@Number is a small group intervention led by a TA; the sessions are for 20 minutes with each group of three or four children. Numbers Count, led by

a trained teacher, is implemented as a one to one programme, with each session lasting 20 minutes. Other year groups are assigned TAs who go over key number concepts with them.

Progress, for all children in maths, is closely monitored by the maths lead and the assistant head teacher who do half termly 'learning walks'. Further support is given to children through a robust system of one to one tuition which takes place after school and on Saturdays. This is led by teachers, TAs and some external qualified tutors.

Parent engagement

There has always been a strong leaning towards maths at Elmhurst, with the result that children love maths. Maths, a priority subject at the school, is strongly supported by parents; they are pleased that their children are pursuing the subject. **The school runs parent workshops** which involve giving parents a brief synopsis of the lessons and what their children are doing; parents are happy to support their child's learning at home.

Improving children's outcomes in maths: Key to success

- **Change to mixed ability groups coupled with the introduction of the Singapore mastery approach - slower learners are now exposed to richer maths.**
- **The staged mastery approach to teaching maths - concrete, pictorial and abstract.**
- **Focused training of teachers and teaching assistants.**
- **With the 'new' approach teacher expectations for children's learning and outcomes have been raised.**

Looking to the future

- **Children have the opportunity for maths in different subjects, but it is not yet fully embedded. This is an area for development over the coming year.**
- **Elmhurst wants to fully embed the Singapore mastery approach across the school; the head of maths believes this will take two more years.**

Grafton Primary School, Islington, London

Why children at Grafton Primary School do well in maths: Key statement from the deputy head teacher:

“High quality teaching, expertise of staff and enabling children to make connections within and between mathematical concepts which helps to build intelligence...there is a way of working across the school where children are encouraged to embrace their mistakes and see them as spring boards to learning”.

Key school data

(2015)

540 pupils age 2-11 years

56% of pupils are Pupil Premium

57% of pupils are EAL

20% of pupils are SEN with support

Key performance data

In 2015, 95% of pupils achieved Level 4+ in maths, with 64% achieving Level 5 maths and 34% achieving Level 6 maths (9% national average).

The disadvantaged pupils who were in Year 2 in 2011 made the following progress:

- Expected progress disadvantaged pupils 100% (91% national average for **all** pupils)
- More than expected progress disadvantaged pupils 59% (37% national average for **all** pupils)

Context

Grafton is a lead school for a Teaching School Alliance in Islington, North London. The approach to maths within Grafton is very much rooted in its vision for **‘all children to achieve within a creative environment with classrooms and teaching of the highest quality’**. There are opportunities to share good practice through alliance and local authority meetings as well as through their membership of the local school cluster, **Future Zone Islington**.

Grafton has been involved in **Let’s Think Maths** for fifteen years and this particular approach is embedded in the curriculum. The strong history of excellent maths teaching and learning is reflected in various Ofsted reports. Grafton was praised for its excellence in maths teaching in 2009 and in the 2011 Maths survey, where Ofsted attributed the rich and deep maths curriculum to the Let’s Think (Cognitive Acceleration) approach.

Let’s Think Maths, is initiated in the classroom through a story or practical context. Children are introduced to the rules of the problem and through talk they have to solve the problem. Children tend to like the whole class (mixed ability) approach. Talking through maths problems and solutions helps the children to understand the ‘how’ of learning (metacognition) and enables the children to lead the learning, with the

expert guidance of the teacher as facilitator. Although teachers are trained in the approach, in many ways it is challenging for teachers to facilitate, because they cannot fully direct the lesson; teachers go where the children take them.

Let's Think Maths lessons are taught once a week or every fortnight; the approach is enhanced when the Let's Think Maths pedagogy is brought into other timetabled maths lessons. It is particularly beneficial for low achieving pupils; all answers are fruitful opportunities for talk, particularly those containing misconceptions. It also challenges the higher attaining pupils who analyse and monitor their own mathematical strategies independently.

In 2015, Grafton introduced the **Mathematics Mastery programme** in Reception and Year 1; a programme aimed at improving pupils' understanding, enjoyment and attainment in mathematics. Based on research and internationally recognised practice, particularly drawing on evidence from Singapore and Shanghai, it is a professional development programme for teachers.

Mathematics Mastery is underpinned by key principles including high expectations for every child, teaching fewer topics in greater depth, and emphasising problem-solving and conceptual understanding.

Mathematics Mastery sits well alongside the **Let's Think Maths** programme because they both focus on the development of reasoning in a mixed attaining classroom and encourage children to be independent thinkers.

This case study focuses on the changes to teaching and learning across the school and the ways in which they have improved children's maths outcomes.



Approach: general

Let's Think Maths is a whole school approach at Grafton. Through the questioning approach it enables children to think for themselves. It both stretches and challenges children whilst enabling them to work independently and develop their own strategies to solve mathematical problems. In practice, **Let's Think Maths** enables children to apply skills taught in numeracy lessons and allows teachers to assess how well children have mastered their maths: have the children really learnt what teachers have taught? Both teachers and teaching assistants have benefited from Let's Think professional training over a number of years and maths results across the school have significantly improved over time. Grafton also introduced **Philosophy for Children**, which the deputy head teacher believes has also supported children in the 'thinking' approach.

Mathematics Mastery

Mathematics Mastery has a strong focus on conceptual understanding. The use of rhymes and songs as children move from one activity to another reinforces prior learning. In addition, children have maths meetings every day to consolidate the day's learning. The mastery approach has brought a strong focus on number, calculation, making maths real, using games and problem solving, which complements the **Let's Think Maths** lessons. Grafton found that the children's **Let's Think Maths** experiences had given them a

head start in understanding and using the concrete and pictorial models of **Mathematics Mastery**.

Interventions

Grafton has moved from big group 'catch-up' intervention programmes to small group or 1:1 'keep-up' sessions either with a teacher or a teaching assistant. Children are identified according to area of need through **Let's Think Maths** and **Mathematics Mastery** and have 20 minutes extra numeracy every afternoon. The particular approach to identification of children by specific area of need means that it will not necessarily be the same children every day.

Parents

There are classes for parents and children to work together; these are often focused on areas which are perceived to be 'difficult'. Teachers show parents what their children are doing in class and how they do it. Teachers say to parents that children need to find the most efficient way of working which is based on the 'fewest steps' in their calculations (again this focus on efficiency is integral to the **Let's Think Maths** approach). **The school also organises regular maths events and parents are involved in these activities.**

Improving children's outcomes in maths: Key to success

- High quality problem solving and application through the Let's Think Maths approach.
- High quality teaching, supported by ongoing Let's Think Maths professional learning for teachers and TAs.
- Enabling children 'to make connections within and between mathematical concepts thus building intelligence'.

Looking to the future

- 'Never rest on your laurels'.
- Grafton is running Let's Think Maths programmes for other schools. Previous courses had excellent feedback.
- The school is aiming to increase the already high proportion of children who achieve highly by focusing on developing a deep conceptual understanding in maths.

Why children at Parkfield Community School do well in maths: Key statement from the assistant head teacher:

“A key factor of our success has been the good development of teacher subject knowledge, built up through ongoing and focused CPD. And, with children we always start a lesson with a problem, not with objectives; children are thinking from the very start of a lesson. We always look ‘outside’; we have developed our approach to teacher research and have been involved with the Shanghai/Singapore mastery teaching programme. I always say to teachers, that maths teaching can be based on the Hippocratic Oath of doctors: ‘First do no harm’. We want everyone to be enjoying maths and happy doing maths”.

Key school data

(2015)

741 pupils age 3-11 years

34% of pupils are Pupil Premium

77% of pupils are EAL

11% of pupils are SEN with support

Key performance data

In 2015, 99% of pupils achieved L4+ in maths; 64% achieved L5+ and 11% achieved L6.

In 2015, 94% of disadvantaged pupils achieved L4+ in maths.

In 2012, 66% of pupils achieved L4+; 27% achieved L5+; there was no L6.

Context

Parkfield, situated in one of the 10% most deprived neighbourhoods in the country, converted to an academy in 2013. In 2015, the school was awarded a **National Pupil Premium Award** for being one of the most improved schools in the country. This year, it was rated **outstanding by Ofsted across all areas**; in 2012 Ofsted had rated the school good. In 2013, the assistant head became the maths lead for the school and made a number of changes in both primary and early years: ‘to address maths in primary school, you need to start in the early years’. As a maths lead, she completed MaST training at Edge Hill University and the PD Lead training with NTCM. The school now has three maths specialist teachers and six professional development leads accredited by the NCETM (National Centre for Excellence in the Teaching of Mathematics). They are strategic partners with **Central Maths Hub** and the maths lead is a **Mastery Specialist Teacher** and joint Mastery Lead for the Central Hub. Through her own training, research and experience, she realised that teachers need focused, maths specific CPD in order to enhance the learning experiences of pupils – particularly with the higher expectations of the National Curriculum and statutory assessments.

.....

Approach: general

The maths lead began by completely raising the profile of maths. The phrase ‘I can’t do maths’ was banned and there was a focus on making maths enjoyable for everyone; staff, children and parents.

A programme of intensive training was introduced for all staff in 2013/2014; one after school session per month, with a particular focus on teacher subject knowledge. This has now become a rolling programme of more bespoke CPD for staff who identify gaps in their knowledge or for NQTs, student teachers, or any teacher new to the school. Most teaching staff have completed a Subject Knowledge Enhancement course (Teacher Subject Specialist Training) which a team of staff at Parkfield deliver for/on behalf of the Maths Hub (available to any primary teacher free of charge, funded by NCETM through the Maths Hubs Programme). The school is involved in a number of research projects through school initiated projects and the NCETM.

As maths lead, time is spent on developing and embedding good maths practice across the school; she no longer has responsibility for class teaching. She supports teachers through coaching, mentoring, and with planning, giving them ideas to apply maths in other subjects; for example, times tables for warm up sessions in PE. Staff are encouraged to come up with further ideas, knowing they can go to the maths lead with questions or ideas.

The maths lead and senior leaders closely monitor flipcharts used for lessons, which have replaced paper plans at Parkfield, and regularly check children’s learning in books.

Content and approach

The focus in maths is the **mastery approach; teaching children to understand concepts through a concrete, pictorial and abstract approach.** The school was involved in trialling the Singapore textbooks and since has been gradually introducing Maths No Problem books. They are now used with Years 1-4. The maths lead sees the textbooks as a ‘tool’; they have helped teachers to adapt to the mastery approach of teaching. She is quick to add that *‘It’s not what you do, but the way that you do it. It is the pedagogy which can transform teaching; the textbooks are a just good resource, not a magic wand’.*

The school is well resourced in maths from the nursery to Year 6. Staff are well trained to know which resource to use for which mathematical concept. Resources are carefully planned into activities to get the most out of them.

All children work in mixed ability groups; this is influenced by the maths policy of not deciding in advance that a child ‘cannot do’ maths. Children’s learning is scaffolded and the rate at which children work is not necessarily accelerated; they tend to work at the same pace, but some will work at greater depth than others.

There is a very secure assessment system in place. Years 1-4 have split maths lessons. That is, they have half the lesson, a break and come back for the second half of the lesson. Years 5 and 6 have an hour of maths, whilst early years children have 20 minutes (in early years, maths is mainly developed through play). In this way children are closely monitored and if a child fails to grasp the concept, they have 20 minutes (1:1 or a small group of children) with a teacher on the same day.

Interventions

Every Child Counts programmes were introduced a few years ago; the programmes were very successful. However, since the school changed its approach to maths, gaps in children's learning are identified more quickly. The resources and some of the strategies of **Every Child Counts** are still used across the school and what they learnt through the intervention programmes has supported their implementation and development of the **mastery approach**. There is still a need for ongoing intervention and with older children **Numbers Count, Success@Arithmetic** and **1stClass@Number** are used for identified children.

Cross curricular

The maths lead believes that the maths curriculum has changed so much that there would not be enough time to cover everything in one hour of maths alone; it needs to come into other subjects. Ideas might include, children using stop watches in PE to time themselves running and then to record this graphically or in a table. Equally in science, there are many opportunities for measuring and recording findings in a graph or table. A lot of teaching is in topics across the school; a recent topic on the Ancient Greeks enabled the children to look at the various aspects of geometry. **Through making such cross curricular links, children also see the importance of maths and the wider applications it has, beyond just number.**

Parent engagement/ home learning

Bespoke maths workshops are organised for parents at least once a term. They are based on 'home' maths, that is, parents doing maths with their children and not teaching 'new' maths. They focus on maths as fun and include games parents can do with their child for five minutes in the evening. These workshops address areas such as counting, numbers, number bonds and the vocabulary around maths. The aim is to enable parents to be interested, enthusiastic and happy about maths and doing maths with their children. **Mathletics** is available for Years 2-6, where the children can log-on and do this at home; parent workshops teach parents how to monitor this work at home.

Improving children's outcomes in maths: Key to success

- **Good development of teacher subject knowledge, built up through ongoing and focused CPD.**
- **Children starting lessons with a problem written on the board and practical apparatus to explore this problem.**
- **Teacher research.**
- **The learning from being involved with the Shanghai teacher exchange, Singapore style textbooks and the NCETM mastery programme.**
- **Enabling everyone to enjoy maths and be happy doing maths.**

Looking to the future

To focus on further developing children's reasoning skills and number sense and supporting them through that in their independence as learners. Early years and primary school is where they build the foundations for lifelong learning.

Why children at Pound Hill Junior School do well in maths: Key statement from deputy head teacher (maths lead):

“A culture of maths across the school; everyone can achieve and maths is everywhere. We want the children to see how the different elements of maths link to real life”.

Key school data

(2015)

362 pupils age 7-11 years

13% of pupils are Pupil Premium

21% of pupils are EAL

Key performance data

In 2015, 87 % of pupils achieved L4+ in maths, with 48 % achieving L5. 69 % of disadvantaged pupils achieved L4 in maths, with 31 % of disadvantaged pupils achieving L5 in maths.

Closing the Gap % difference at L4:

2013: 52 %

2014: -3 %

2015: -18 %

Closing the Gap % difference at L5:

2013: 36 %

2015: -17 %

Context

Pound Hill Junior School is situated in a relatively affluent part of the south east of England amongst the 50 % least deprived neighbourhoods. It has half the national average of pupil premium children, but they all do well in maths; every teacher can name their pupil premium children.

In 2011 Pound Hill Junior School asked a team from the National Mathematics Partnership to audit their maths provision, highlight strengths and gaps and provide training for teachers and teaching assistants. This was the beginning. The school has adopted elements of the Singapore mastery approach to teaching maths. As the deputy head teacher emphasised: ‘we are not interested in the answer. We want to know how they solved it in their head’. This has been encouraged and promoted by the National Mathematics Partnership focus on number and number sense which the school has continued since 2011; children look at the number 25 and consider all the ways this can be presented, for example, $24+1$, 5×5 , etc.

The school’s approach to maths was further supported by their participation in the teaching team for the National Centre for Excellence in Teaching Mathematics (NCETM) Teaching for Mastery programme, where

participants met every three to four weeks, watched maths being taught and brought back what they had learnt to the school. Pupil voice is strong and questionnaires are regularly used to find out their views on particular areas/issues. Time specific action research projects are common, exploring different approaches or teaching and learning strategies. For example, a recent half-term project looked at the impact of chanting times tables and how much it improved times table retention and retrieval.

The deputy head teacher continues to attend maths hub meetings every month and is the locality maths co-ordinator for six primary schools and one secondary school as well as being part of the moderation group which meets every half-term; she is also an Associate Adviser/ SLE's in maths (Specialist Leader of Education).

Anecdotal reports from a 'feeder' secondary school show that children from Pound Hill Junior do well in maths.



Approach

The senior leadership team at Pound Hill wanted to raise the profile of maths across the school and create a maths culture. This was achieved through maths updates to parents, a maths week, a times table week and the use of the school website. Maths is now everywhere, with pictures and problem-solving examples in the corridors.

Content

For all children, every maths lesson includes a focus on numbers, fluency, problem solving and reasoning. Maths is linked to 'real-life' application and with the mastery approach children develop curiosity. With the introduction of the new National Curriculum in 2014, the school added two extra arithmetic lessons a week for all children.

Textbooks are used for reference and ideas only and planning is done for a whole year group.

About 75% of lessons are focused on number and the concept of number. And there is the hope that as this approach becomes more embedded in the school, there will no longer be a need to 'gap fill' for some children.

Interventions

Interventions were introduced for children not reaching age expected level; Rapid Maths for Years 5-6 and Catch Up Numeracy for Years 3 and 4. Children identified for interventions are very specific; for example, a child who cannot tell the time will have an intervention for a few weeks. Those participating in an intervention will have 1:1 or small group pre-teaching with a teacher prior to a lesson.

Maths-Whizz was introduced for pupil premium children. The school purchased 60 log-ins and got the children set up over the summer. They work on this at home, with teachers logging-in to look at the work and make constructive comments.

Pedagogy

In Year 6 there are booster maths classes before and after school. And, across the whole school there are maths meetings three to five times a week, held outside lessons where children work on number sense, fluency and playing with numbers; for example, how many different ways can you show 25?

Pupils like maths; this is reflected in the termly pupil preference questionnaire sessions, when children have to say what they like doing at school and why, or equally what they dislike. Many will say that they like maths.

Grouping

All classes are mixed ability. Pupil progress is closely monitored on a daily basis, with formal monitoring every half term. The daily system for assessing children's progress is based on a 'traffic light' approach - green, orange, red - where children are encouraged to self-assess their work. This system allows the teacher to quickly identify any child needing an intervention.

Cross curricular

Opportunities for maths are identified across the curriculum, with a lot of graph work in geography and science, and scales and angles in art. It is often closely linked to 'real-life'; for example, during the World Cup children would work through problems relating to the number of kilometres a player had run during the course of a game, and the astronaut Tim Peake and his approach to 'maths in everything' is followed.

Parent engagement/home learning

The school emphasises the importance of number sense to parents, where maths ultimately aims for problem solving in the 'head'; this is encouraged through a four step rule of which parents and children alike are made aware of:

1. Can I do it in my head?
2. Can I do it in my head with jottings?
3. Do I need to use a more formal written method?
4. Do I need a calculator?

This is discussed with parents and the school shows them how they can support their children at home in developing in this way.

Every six months there are workshops for parents, which focus on the four rules of addition, subtraction, multiplication and division. The parents are keen to understand what their child is doing and how they can support that at home.

The National Numeracy parental engagement project in which the school participated helped develop this. A lot of mums would say 'I can't do maths' and through the project these barriers were gradually broken down.

Improving children's outcomes in maths: Key to success

- Raising the profile of maths: maths everywhere.
- High expectations for children: everyone can achieve.
- Focused teaching on number, fluency, problem solving and reasoning every lesson.

Looking to the future

The school is considering introducing 'same day intervention', where children have half a maths lesson, then a break, during which time the teacher marks their work; children then return for the other half of the lesson and the teacher can teach to correct errors. With curriculum changes, the deputy head teacher believes it is very important to fully embed the school's maths approach: **'Every child should know their times tables by the end of Year 4. Poor recall of numbers is what holds children back in Years 5 and 6'**.

Hillside Avenue Primary and Nursery School, Thorpe St Andrew, Norfolk

Why children at Hillside Avenue do well in maths: Key statement from head of maths:

“Because they develop a deep understanding of key mathematical concepts. The new National Curriculum is good for that, because it calls more for depth than breadth, with a focus on number, place value and calculation. These are the most important things to focus on and if the children get these, they have got it”.

Key school data

(2015)

460 pupils on role (age 3-11years); 2 form entry

3% of pupils are SEN with support

11% of pupils are EAL

11% of pupils are Pupil Premium

Key performance data

In 2012, 80% of pupils achieved Level 4+ in maths, with 73% making expected progress between KS1 and KS2.

In 2015, 98% of pupils achieved Level 4+ in maths, with 98% making expected progress between KS1 and KS2; 59% of children achieving Level 5+ in maths.

Disadvantaged pupils generally perform well.

In 2013, 100% of disadvantaged pupils made expected progress between KS1 and KS2. In 2014 this figure was 73% and in 2015 this figure was 100%.

Context

Hillside, situated in Thorpe St Andrew, a small town/suburb just a few miles east of Norwich, is in one of the 30% least deprived neighbourhoods in the country. In 2012 the school received a requires improvement rating from Ofsted. Less than three years later, in April 2015, the school was rated good.

.....

Approach

Ofsted 2012 marked a turning point for the school and following a Local Authority monitoring risk assessment, Hillside initiated a number of changes.

Changes

The biggest change in maths was the move towards a mastery type approach; every lesson from nursery to Year 6 is now founded on the ‘concrete, pictorial, abstract’ base of the mastery approach to teaching maths. The school invested in Numicon resources, supported by pupil premium funding and staff

training. Each classroom has four sets of Numicon shapes which are used by all children. Other resources include bead strings, counting sticks, fraction plates and strips and counters.

Maths Culture

A maths culture is beginning to develop across the school, encouraged and supported by staff training; the test will be when every teacher can say 'I love maths'. The culture is also supported by a move towards enquiry based topics. Every term there are two, three-week enquiry sessions focused on a particular topic. This may be history or geography or science; there is always a maths focus running throughout.

The first week of every spring term is devoted to enquiry based learning in maths. During this time, children are supported in developing the independent skills needed for learning in school and beyond. This year the school and nursery followed the Noah's Ark NRICH activity.

Teachers do their own planning, asking the head of maths for advice if they are not sure how to approach a particular area. All planning is fed back to the head of maths; at a glance the head of maths knows what is being taught in each classroom.

Whole class approach

There is a whole class approach to teaching, in the sense that all children work on the same curriculum content. However, with the school's focus on enabling children to take responsibility for their own learning, children will often be working on different activities or as they are referred to by the school, challenges. Children choose what challenge they want to do, which is overseen by teachers to ensure that the selected activity provides appropriate challenge. This approach is part of the way the school supports children in developing a growth mindset; an idea developed from cluster meetings in 2014-2015.

Pupil progress is closely monitored across the school, using the Pupil Asset Tracking system. Key performance indicators are tracked on the system and teachers can see if children are working at, above or below the expected level for a particular area of maths. In addition, there are pupil progress meetings each term between the class teachers and the subject leaders for maths and literacy.

Interventions

Maths interventions are less common than they used to be, but are still employed for children who do not grasp a concept. Interventions happen outside of maths lessons; they are structured, last for no more than six weeks and children's progress is closely monitored. For Years 2-4 **Catch up Numeracy** is used. Teachers and teaching assistants are trained in that and identified teachers are released from lessons to teach it. Children are tested at the start of an intervention.

Parent engagement

The school holds parent workshops twice a year, one for each Key Stage. The focus is calculation and how parents can support their children at home. The particular approach to maths is explained. The head of maths is clear that parents need to be giving the message to their child that they (the parents) can do maths and that they like it. Being part of Achievement for All contributed towards improvement in maths; time spent discussing children with their parents led to some surprises about how maths was perceived by the parents as well as the children. Hillside addressed these issues.

Collaboration with other schools

The head of maths is part of the local Norfolk maths primary network, which meet termly to discuss what is

happening in maths nationally. They share good practice and discuss challenges for teaching and learning. The head of maths also visited other schools when developing the enquiry based approach to learning.

Improving children's outcomes in maths: Key to success

- The 'concrete, pictorial, abstract' approach of maths teaching for mastery has been key to deepening children's understanding of maths.
- Training teachers in this approach.
- Close tracking of pupil progress.

Looking to the future

"Generally the maths mastery approach is fantastic; we use many aspects of that approach. We want to further develop and embed that in the school".

Hillmorton Primary School, Hillmorton, Rugby, Warwickshire

Why children at Hillmorton Primary School do well in maths: Key statement from the head of maths:

“The explicit mathematical language encouraged and promoted through Mathematics Mastery and children’s conceptual understanding”.

Key school data

(2015)

230 pupils age 4-11 years

25% of pupils are Pupil Premium

7% of pupils are EAL

22% of pupils are SEN with support

Key performance data

In 2015, 88 % of disadvantaged children achieved Level 4+ (national average: 80 %); for all other children, this figure was 96 % (national average 90 %). 100 % of all pupils made expected progress in maths.

Context

Hillmorton joined the Mathematics Mastery programme in 2014, broadly at the same time as the new curriculum came in. At its last inspection in 2013, the school had been rated ‘good’ by Ofsted and wanted to further develop maths in terms of depth and across the school. Mathematics Mastery provided what they wanted.

This case study focuses on the changes the maths lead made across the school to further enhance children’s outcomes.



Approach: general

For Hillmorton the biggest change was in both the use of, and way of using, mathematical language. Mathematics Mastery uses a carefully sequenced, structured approach to introduce and reinforce mathematical vocabulary. Pupils are expected to explain the maths in full sentences (not just what the answer is, but how they know it’s the right answer). This is key to building mathematical language and reasoning skills. All teachers and teaching assistants were trained by Mathematics Mastery as part of their introduction to the approach.

The Mathematics Mastery approach combines the programme’s focus on key principles - particularly success for all, deep understanding and problem solving – with an emphasis on collaboration and professional development of teachers. Teachers are empowered and equipped to deliver the highest quality mathematics lessons, and pupils enjoy their learning, build up confidence and achieve their potential.

Culture

The new approach brought a maths culture change across the school. **The children now focus on conceptual understanding and the development of a positive ‘can do’ mindset.** The result is that children, not weighted down in learning a method, really enjoy maths. As the head of maths says: ‘I never hear a child saying I can’t do maths’.

Hillmorton initially introduced the Mathematics Mastery programme from reception to Year 3. Children in KS1 all follow the Mathematics Mastery curriculum and use their resources; this is supplemented with the school’s own work to add further challenge or provide further support. As an interim measure, until the approach becomes embedded across the school, children in KS2 use Inspire Maths, the OUP textbook series.

Interventions

As children become immersed in the Mathematics Mastery approach with its rich environment, they grow in confidence and mathematical fluency. Children are ‘picking up’ concepts more quickly and interventions are used less and less across the school.

Topic approach

Maths, where possible, is applied across all subjects in the school. The topic approach enables opportunities for maths to be identified across the curriculum. For example, a recent history topic, code breaking during the second world war, provided good opportunities for maths.

Children’s work is closely monitored by the class teacher and senior leadership team. The head of maths carries out regular book tours and scrutinies of children’s work; the School Improvement Partner provides a monitoring and evaluation overview.

Parent engagement/home learning

Hillmorton has high expectations for children’s learning and outcomes. This is shared with and by the parents.

Improving children’s outcomes in maths: Key to success

- **Mathematical language emphasised in the Mathematics Mastery programme - children must speak in full sentences to describe what they want to say. This has had a knock-on effect across their learning.**
- **Conceptual understanding - children manipulate the ‘concrete’ to represent mathematical concepts.**

Looking to the future

To further embed the Mathematics Mastery approach across the school.

John Scurr, Stepney Green, London (Tower Hamlets)

Why children at John Scurr Primary School do well in maths: Key statement from the head teacher:

“All the children all the time ...knowing about the whole child, the whole day...”

Key school data

(2015)

471 pupils age 3-11 years

49% of pupils are Pupil Premium

94% pupils are EAL (April 2016)

16% of pupils are SEN with support (April 2016)

Key performance data

In 2015, 86 % of pupils achieved L4+ (77 % L4b+) in maths, 40 % L5+ with 4 % achieving L6.

86 % of disadvantaged pupils achieved L4+ in maths.

94 % of disadvantaged pupils made expected progress in maths between KS1 and KS2; this compared with 94 % of all other pupils.

In 2014, 89 % of pupils achieved L4+ (80 % L4b+) in maths, 31 % L5+ with 13 % achieving L6.

88 % of disadvantaged pupils achieved L4+ in maths.

95 % of disadvantaged pupils made expected progress in maths between KS1 and KS2; this compared with 94 % of all other pupils.

Context

When the head teacher started at John Scurr two years ago, children worked in ability sets for maths. The bottom and middle groups were not making the progress they should have been. Transitioning to ability set group during the day caused disruption to learning. The head teacher changed the approach. In 2014, the school was rated good by Ofsted, as it had been in 2012. Situated in Tower Hamlets, the school is in one of the 20 % most deprived neighbourhoods of the country.

This case study looks at the positive changes the school has made in its approach to maths teaching and learning.

.....

Approach: general

Last year the head teacher introduced whole class teaching for maths, with class teachers using high quality differentiation, flexibility in their approach and good feedback. This has enabled the teachers to get to know the ‘whole child’; prior to this some children had different teachers for maths, with the result that the

class teacher was not aware of the children's approach to maths or the particular way their talents were manifested.

Content and approach

The school uses the Trinity White Rose maths programme, focused on building confidence and resilience in maths teachers and pupils through a mastery approach to teaching. It places emphasis on the language of maths and problem solving. Every class has a maths corner displaying maths language and a maths trolley. Children are free to access the trolley which contains number lines, shapes, measures, calculators blank number squares and times table squares.

The school introduced talking/learning partners, where each child will talk to another child about their learning and provide feedback. Children swap partners, so that they are not always working with the same child.

Once a week volunteers from Lloyds come to the school. Referred to as Number Partners, they work with Year 3 pupils playing number games. This interaction with outside adults and revolving around numbers has been very successful in terms of increasing children's confidence; they also help to support and organise the annual money week, which is held in the school. Money week is in addition to Year 6 enterprise week.

Being part of Achievement for All London Primary Programme has had a positive impact across subjects. In enabling teachers to focus on speaking, listening and differentiation, it has encouraged greater independence in the children.

Training

There is a good maths lead in the school, who provides monthly training to staff on classroom practice and the effective use of resources. Further guidance is provided across the school by middle leaders who meet weekly. Teachers knowledge and understanding is further developed by doing their planning together; they look for opportunities to bring maths in to other subjects. The school is part of the Teach East London Teaching School Alliance, so staff have termly opportunities for moderation of children's work. In addition, the local authority provides opportunity for termly meetings of local primary schools.

The head teacher believes it is important that all teaching assistants have a good knowledge of maths. To this end, the school has just signed up to a GCSE Maths course for all teaching assistants, with staff from the University of Cumbria teaching in the school.

Interventions

Numicon is used across the early years, with Little Big Maths used to fill gaps in children's maths higher up the school. And, for KS1 and KS2 children who struggle with a particular area of maths, there are lunchtime catch up classes with a teacher.

Parent engagement/home learning

The school organises Wednesday morning maths workshops for parents; they can find out what their child is learning and how they can work with their child at home. There is a big focus on times tables.

Improving children's outcomes in maths: Key to success

- **Good questioning (teacher).**
- **Good teaching.**
- **Whole class approach (not ability setting).**

Looking to the future

Develop maths resilience. The maths lead is working on this with teachers. Children's learnt helplessness is one of the biggest barriers the school faces in enabling children to move forward in their learning. The new focus is on developing the right mindset, 'what do we do when we are stuck?'

Victoria Lane Academy, Coundon, Durham

Why children at Victoria Lane Academy do well in maths: Key statement from head teacher:

“Our use of pre-assessment and on-going daily planning, set within a meaningful context; children engaging in real-life problem solving. All of this has helped to develop a positive maths culture.”

Key school data

(2015)

156 pupils age 3-11 years

56% of pupils are Pupil Premium (national average: 26%)

28% of pupils are identified as SEN support (national average 12%)

1% of pupils are EAL (national average 19%)

Key performance data

In 2015, 100% of pupils achieved L4+ in maths, 50% achieved L5+, with 14% achieving L6.

100% of disadvantaged pupils achieved L4 in maths, with 86% of disadvantaged pupils achieving L4B+ in maths.

In 2011, 61% L4+; 28% L5+.

In 2012, 73% of pupils achieved L4+ in maths, 35% achieved L5+.

Context

The head teacher started in September 2013 and made a number of immediate changes, including introducing the ‘new’ draft maths curriculum to give all teachers ‘a head start’. Life without levels in the same year saw the development of the school’s own assessment system based on key objectives for the year group. From this base the school developed a cohort action plan for all pupils, supported by the rigorous analysis of pupil data every half term. This approach meant all teachers were part of and contributing to the change process from the outset.



Changes: Assessment and planning

Two weeks before pupils are taught a new topic in maths, each child does a written pre-assessment to find out where they are in their learning. Teachers plan for each child, differentiating work accordingly. Planning is done on a daily basis; after day one of teaching the topic, teachers plan for day two. At the end of the topic, which usually lasts two weeks, children have a post assessment. It is very positive for children’s learning; a teacher can say ‘this is where you were two weeks ago and look where you are now’. This type of approach enables teachers to quickly identify any child who needs support.

To provide greater evidence of learning, the school introduced maths stickers, which include extension tasks and further challenges at the end of lessons.

The approach to maths is based on ‘real life’ scenarios. This was purposefully identified through the school’s process of continuous curriculum refinement; the local authority provided the training for ‘real-life’ maths. For example, brochures and catalogues are used and children work out the price of a holiday or they may use menus to work out the price of meals. One year group is studying America and are looking at the different metrics used. Games through ICT and in particular Mathletics are used across the school. The annual business project, where children make a product to sell. For example cakes, provides children with the opportunity to cost materials and work out profit margins; each child is given £5 at the outset. Children are often surprised by the profit they make.

There is a big focus across the school on number. And, in addition to maths lessons, every class has maths and maths skills on a daily basis. Resources include those from NRICH (this aims to enrich the maths experiences of all learners; it is part of the Millennium Mathematics Project, University of Cambridge) and the NCETM maths guide is used by teachers.

The development of maths skills, applied across the curriculum, was initiated through an evaluation and consideration of opportunities for maths. These enabled teachers to identify less obvious areas where maths could be introduced. **The head teacher believes the new curriculum provides more opportunities than before.**

Children at Victoria Lane Academy love maths. Many don’t read well, but maths ‘clicks’ with them and parents value maths. This gives the children confidence. The particular approach leads to accelerated progress in maths. The head teacher attributes this to the school’s pre-teaching rather than catch up approach. For example, in Year 3 (where pre-teaching has been trialled), a teacher will identify an area where a pupil needs some teaching before the lesson; this pupil or small group of pupils will have a short session at lunch time with the teacher.

Pupil groupings

There is a strong positive maths culture across the school, which is enhanced through the pre and post assessment approach; the head teacher believes this is one of the key strengths of maths across the school. Children are grouped according to their pre-assessment; a child good at numbers will work with children of similar ability in this area, but the same child may be less gifted at shapes, so will work with similar ability children on shapes.

There is a teaching assistant in every class; they are deployed according to their strengths. A teaching assistant strong in maths will go into maths classes, whilst those stronger in literacy will go into literacy classes. All TAs have appropriate training and give verbal feedback to children during the lesson. Immediate feedback to children is of central importance. As the head teacher says, ‘**children’s misconceptions can be addressed straight away, otherwise it may be too late**’.

Interventions

Interventions are used when they are needed for some pupils. The school invested in Numicon, again using pupil premium funding for the resources. The maths co-ordinator was trained in the approach and shared this with all teachers across the school. Numicon is used for number development in the Foundation Stage and KS1 and as an intervention for any child who needs it in KS2.

There are maths skills after school booster clubs for children in Years 2 and 6; the focus is on applying skills. Pupil premium funding was used to buy in a specialist teacher for the booster club in Year 6, which also includes developing the skills of children working at or towards Level 6.

Parent engagement/home learning

With the new SATs, the head teacher believes pupils need strong reasoning skills. She further believes this is founded on basic number understanding and rapid recall with multiplication. Looking to the future the school wants to involve parents more in that with a particular focus on times tables. Some parents of children in the school are not as engaged with learning as the school would like. However, parents are happy for their children to attend after school clubs and on Monday evenings, there is an ICT homework club. Homework, across the school, is set on a Friday and returned the following Thursday. At ICT homework club children are allowed to work on the computer once homework is completed. The school currently uses published 'homework books', which provide a guide for children and support them in organising their work. Going forward the school have designed their own homework books which include a reading record, an area for learning tables and room for calculations.

Collaboration with other schools

A big part of the ethos across the Academy Trust, of seven schools, is the sharing of skills to improve pupil outcomes, including networking between maths co-ordinators. Within the local area, there are head teacher meetings and also maths co-ordinator meetings. The local authority offers a lot of training; teachers and TAs from Victoria Lane Academy access this according to self-identification of gaps.

Improving children's outcomes in maths: Key to success

- **Pre and post assessment of children for new topics.**
- **On-going daily planning of class teachers.**
- **Setting maths within a meaningful 'real-life' context.**
- **Engaging children in 'real-life' problem solving.**

Looking to the future

Embed maths in everything.

Wroxall Primary School, Isle of Wight

Why children at Wroxall Primary School do well in maths: Key statement from deputy head teacher (head of maths):

“A combination of high expectations, the delivery of maths in a way that excites and builds interest coupled with equally high parental engagement in both their children’s learning and their own.”

Key school data

(2015)

160 pupils age 4-11 years

30% of pupils are Pupil Premium (national average 26%)

15% of pupils are identified as SEN support (national average 12%)

0% of pupils are EAL (national average 19%)

Key performance data

(KS2)

In 2015, 100% of pupils achieved L4+ in maths, with 64% achieving L5.

100% of disadvantaged pupils achieved L4+ in maths.

In 2014, 100% of pupils achieved L5+ in maths.

100% of disadvantaged pupils achieved L5+ in maths.

In 2013, 92% of pupils achieved L4+ in maths with 38% L5+ in maths.

86% of disadvantaged pupils achieved L4+ in maths.

Context

Wroxall Primary School, on the Isle of Wight, is situated in one of the 40% most deprived neighbourhoods in England. In 2011 Ofsted rated the school ‘satisfactory’, two years later that was upgraded to ‘good’. As a result of its success, the school has doubled in size since 2013. Wroxall is a federation of three schools, with two executive head teachers. The deputy head teacher, also head of maths, has responsibility for developing maths across the federation. He was a lead practitioner in maths and also involved in the STEM project. This case study will consider the changes made to bring about such significant improvement in children’s maths outcomes.



Approach

In 2010 the school changed from a two to a three tier school, expanding to include Years 5 and 6. This marked a turning point for Wroxall, with staff wanting to further develop themselves professionally; a number followed the MaST programme.

In 2014, the head of maths set up a City and Guilds functional maths course to enable parents to engage with maths. Following the success of this he set up a GCSE programme for parents and staff. This is very popular across the school and a driving force behind the success in children's maths.

Changes

Wroxall set high expectations; staff are now very positive about maths. To enable the school to 'tap into' the new curriculum, the head of maths developed a set of resources - objects, combined with Numicon and Inspire Maths (textbook based on the Singapore mastery approach).

A maths competition, based on the times tables, was developed for all children across the school, with the competitive element helping them to further engage with maths. There is one competition a week and children compete to win a silver, bronze or trophy badge.

Pedagogy

Wroxall's calculation policy is displayed in every classroom, which is also the basis for teacher professional development. The policy gives staff an overall picture of a particular area. For example, how to teach long-division. Across maths, there is a focus on conceptual understanding; that is, children must understand the concepts.

The school introduced a teaching system based on 'ladders to success'. For example, a teacher will design a lesson with various steps. Each one is a step for the child to climb. It enables the children to engage. For example, if children are considering decimals a step may state 'Why is 2×0.6 not 0.12 ? The ladder approach also provides a way for the children to dialogue with the teacher and each other.

The standards developed by the National Centre for Excellence in the Teaching of Mathematics (NCETM.) are used for problem solving, whilst their mastery resources are used for calculation. Teachers teach to the 'top', so that all children have the opportunity for this level of challenge.

Interventions

The school has a policy that 'every child can achieve'. If a child has not grasped a particular concept in the lesson, a teacher will spend time with the child. Teaching is structured to include discrete differentiation. For example, an exercise in rounding numbers to two decimal places, where there are fewer numbers after the decimal place for children who are less strong in this area (10.125) and more numbers for children stronger in the area (10.125436678). The head of maths believes that this approach ensures children are not put off maths. To support the development of a positive mindset, children use Poker chips; through playing the game they learn that there are further opportunities to win back lost chips. For some children, Numicon is used as a targeted intervention.

Maths across the school

Maths is built into other subjects across the curriculum, for example, science and technology. The head of maths produces an overall long-term plan for maths, which provides the framework for planning.

Parent engagement/ home learning

Parent engagement, has in part been supported through Wroxall's involvement in the parental engagement project run by the charity National Numeracy. This focused on joint homework tasks between the parent and the child, with an emphasis on maths being fun. Examples included cooking and measuring, or using hands to measure the height of members of the family, and encouraged them to ask questions; for example, how many hands difference are there between family members. This was particularly helpful for engaging parents who had had a bad experience of maths at school, or felt they could not do maths. Parents have been further engaged through the school's provision of GCSE Maths for both parents and staff; this has been a key factor in children's success in maths.

Improving children's outcomes in maths: Key to success

- **High expectations for children's outcomes.**
- **A focus on concept rather than method (which makes it more enjoyable for children).**
- **The weekly times tables competition.**

Looking to the future

“We can never standstill. The whole maths environment is changing nationally. We want to increase children's ability to problem solve and improve parent's engagement. Times tables, number bonds and counting are the corner stones in maths.”

Summary: Primary Schools

The following summary provides a brief overview of the particular practices, approaches and actions common across the primary schools which were considered to be instrumental in the development of maths.

Teacher subject and pedagogical knowledge

Across all primary schools there is a strong focus on the development of teacher subject and pedagogical knowledge. This is supported through clear maths leadership, particularly where leaders support staff in identifying gaps and developing maths/culture of maths. In these schools the lead also encouraged the development of maths across subjects and teachers were trained in how to use resources effectively to maximise children's outcomes. Maths co-ordinators/maths leads were part of strong maths networks which met regularly to discuss best/'new' practice. This was enhanced when schools had a 'teacher research' focus and/or a focus on encouraging staff to obtain further qualifications. For example, a school provided a GCSE maths course for staff and parents, other schools supported and encouraged MaST (Mathematics Specialist Teacher programme).

Content: a focus on the essentials

The new national curriculum for maths (DfE, 2014), with its focus on depth and emphasis on number and calculation has enabled these schools to focus teaching and learning on the essential foundational blocks for problem solving and reasoning. In many schools at least 70% of lesson time is spent on number and the concept of number, for example how many ways can you show me three? In many schools, problem solving and reasoning are interwoven into lessons. This is most effective when these areas are purposefully addressed. For example, in one school, number, fluency, problem solving and reasoning are addressed in every lesson in every year group.

Knowing the child

Good assessment, linked to planning (frequently daily planning) was evident in the schools. Teachers know where the children are in their learning, where they need to get to and how to get them there. There was a focus on immediate feedback and correcting misconceptions as they arise. Some schools were trialling the split lesson practice of the Singapore mastery approach, where children have half a lesson, have a break and come back for the second half of the lesson; the teacher then teaches to the strengths, weaknesses or challenges of each child. In another school, a key strength of their approach was a pre and post maths topic assessment (written); it provided an opportunity to show children how far they had 'travelled' over the two-week period of the topic.

Making maths fun

Schools are aware of the importance of enjoyment in children's engagement and motivation. In most schools this is done through the changed approach founded on 'everyone can achieve'. It includes the right amount of challenge, with smaller 'steps' for those who need it, teacher/TA support in lessons and 'instant' feedback. It is enhanced through maths games, weekly competitions (times tables) and problem solving set within 'real-life' contexts (for example in one school, brochures and menus are used to work out the price of a holiday or a meal in a restaurant).

Keeping- up

With an increased focus on the 'essentials' of maths, teacher development and pedagogy, including more efficient assessment, teachers quickly identify a child who fails to grasp a concept and address it within the same day. This is done by teachers through one to one or small group work with children prior to the next lesson, through pre and post topic assessment, and through planning (teachers identifying potentially challenging areas and addressing it in their planning). As a result, maths intervention programmes tend to be used for children who 'need it' or as a whole class approach in the lower school.

Changing mindsets and building resilience

Many of the schools have purposefully focused on developing positive attitudes to maths across the school- teachers, teaching assistants, children and in some schools, parents. This has been achieved through developing teacher knowledge and pedagogical skills, ensuring that teachers develop a 'can do' attitude, letting children know that it is good to learn by mistakes and in some schools, a focus on metacognition (e.g. children discussing their learning with a peer).

Parent engagement

There was a general focus across schools on engaging parents in children's maths learning, both in what they were doing in school and reinforcing this at home. This tended to be developed through drop-in lesson sessions (parents watching their child learning maths), work-shops to show parents how to support their child at home, workshops focussing on 'challenging' areas of maths or in one school providing City and Guilds courses and GCSE maths for parents. There was a general focus on developing positive attitudes to maths, showing maths is part of daily life and developing maths at home in the same way it is taught at school. For example, in one school parents were taught how to base learning on a simple four step rule.

Mastery approach to teaching maths

Many primary schools are adopting a mastery approach to teaching maths or some aspects of it. This is mainly through accessing mastery-based curricula, resources or training via the Maths Hubs, or joining the Mathematics Mastery partnership. Inspired by the methodology and practice of Singapore and Shanghai, the mastery approach to teaching maths encompasses three core elements:

- Deep understanding: learners are given time to fully understand, explore and apply mathematical ideas, rather than being accelerated through new topics. This enables pupils to truly grasp a concept, and the challenge comes from investigating it in new, alternative and more complex ways. This is often accompanied by the use of the concrete, pictorial, abstract approach; incorporating the use of objects, pictures, words, numbers and symbols to help pupils explore and demonstrate mathematical ideas, enrich their learning experience and deepen understanding.
- Problem solving: encouraging pupils to identify, understand and apply relevant mathematical principles and make connections between different ideas. This builds the skills needed to tackle new problems, rather than simply repeating routines without grasping the principles. Problem solving goes hand in hand with enabling learners to deepen their understanding.
- Success for all: the mastery approach emphasises the need to have high expectations for every child. All pupils have access to the same curriculum and rich learning experiences, regardless of prior attainment. Teachers focus on enabling pupils to keep up rather than catch up, and by making high expectations

clear, learners are encouraged to build confidence and resilience.

There is an emphasis on developing children's mathematical language. Teachers introduce and reinforce mathematical vocabulary throughout lessons and pupils are expected to explain the maths in full sentences (not just what the answer is, but how they know it's the right answer). This is key to building mathematical language and reasoning skills, and also has a positive impact on literacy.

High expectations

With the greater emphasis on the professional development of teachers and more focused curriculum, teachers have higher expectations for children's achievement in maths. In a number of schools 'high expectations' has been purposefully identified and developed across the school. For example, in one school through the principle 'everyone can achieve' and 'everyone can access learning', and in another school teachers 'teach to the top', putting extra 'steps' in place for those who need them.

Maths culture

This is as much developed through the physical environment as through the ethos. The development of culture was purposeful, often initiated through a focus on 'raising the profile of maths'. This included the development of positive attitudes amongst staff and developing 'maths thinking' in children; in one school all maths lessons started with a 'problem' on the board. Maths culture was further developed through 'maths week' or 'enterprise week' (for development of financial literacy); and in the physical setting, maths culture was reflected in the consistency of the environment - a maths wall in every classroom or Numicon resources across year groups.

How to develop good practice maths in your early years setting

Figures 6 - 9 below show the key areas of focus in early years settings for developing a whole approach to maths. These are leadership and management, progress and learning, health, happiness and well-being and working together. Each figure shows six clear points, informed by the case studies, for developing a whole approach to maths across a particular area. These figures can be used as a professional development tool to support the development of a whole approach to maths. For each point mentioned in the circles, it will be helpful to consider if you do this in your setting, how you do it and as you read the case studies which follow, if you could do it better.



Figure 6: Leadership and management

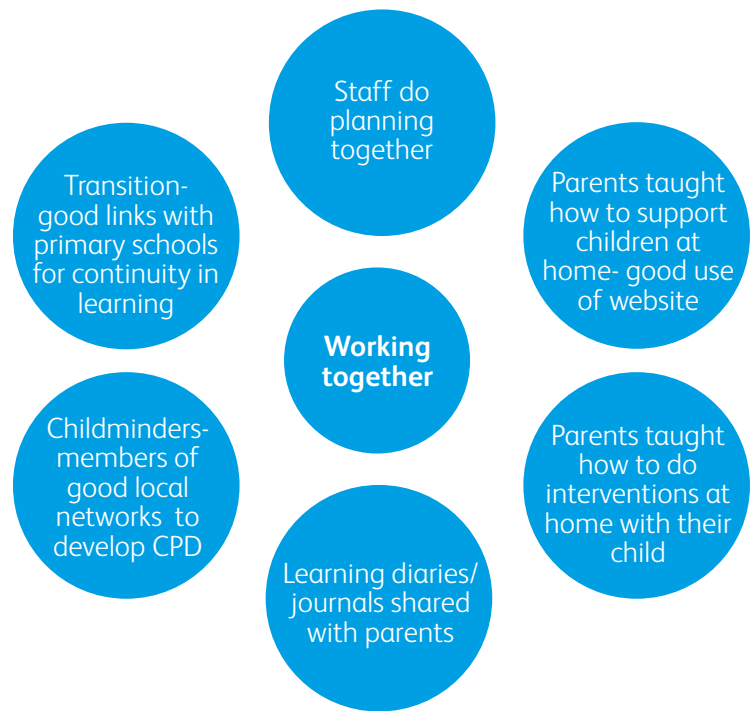
Figure 7: Progress and Learning





Figure 8: Health, happiness and well-being

Figure 9: Working Together



Early Years case studies

Schools: Torpoint Nursery and Infant School, Cornwall

Why children at Torpoint Nursery and Infant School do well in maths: Key statement from the Maths Co-ordinator:

“Through creative, practical and exciting teaching of mathematics we enable our children to not only feel confident using their developing skills, knowledge and understanding to tackle mathematics activities but also to feel pleasure and wonder when children solve a problem for the first time, discover patterns, or notice connections”.

Key school data

322 pupils age 2-7 years

21% of pupils are Pupil Premium

1% of pupils are EAL

10% of pupils are SEN Support

Torpoint is situated in one of the 40-50% most deprived areas in the country, with 17% of pupils living in the bottom 20% of deprived areas.

Most children attend the maintained nursery which is an integral part of the school, with between 5-15% of children joining the school after nursery.

Key performance data

(KS1)

There has been a significant rise in standards over time in maths.

In 2006, 6% of children achieved Level 3, this figure rose to 62% in 2015, with 100% of children achieving Level 2.

In 2015, 100% of disadvantaged pupils achieved Level 2 or above in maths; 67% of disadvantaged pupils achieved L3 in maths.

In 2016, 94% of pupils were assessed as working at the expected standard; 62% of all pupils were assessed as working at greater depth than the expected standard. 93% of disadvantaged pupils were assessed as working at the expected standard; 40% of all pupils were assessed as working at greater depth than the expected standard.

(Early Years Foundation Stage Profile)

In 2015, Number: 2.4; Shape, space and measures 2.3. In 2016, Number 2.4; Shape, space and measures 2.2. National average for both years for both areas was 1.9.

Context

Torpoint, situated close to the Cornwall coast, does very well for its children. In April 2015, the school was rated outstanding by Ofsted, with all pupils making 'rapid' progress in maths along with reading and writing.

Improvements in maths teaching and learning began when the current head teacher and then the maths co-ordinator joined the school. The first priority was to ensure that staff were confident in the curriculum and that there were positive attitudes to maths amongst staff and children.

Numicon was introduced as a teaching and learning resource for all children from nursery through to the end of Year 2; the school uses the resources and some of the diagnostic tools from Numicon, but does not follow the scheme of work.

The maths co-ordinator attended Numicon training and disseminated it across the school. There is clear support for staff development at Torpoint which includes: regular training; staff planning together and an 'ask any time' policy for maths. Work scrutinies and analysis of assessments help identify future developments in teaching and learning.

There is close collaboration between Torpoint Nursery and Infants School and the Junior School to which the majority of children move on to. The maths co-ordinator recommended that Year 3 classes in the primary school use Numicon, which allows for continuity in children's maths learning. Maths co-ordinators from other local schools regularly visit Torpoint to see maths in practice.



Approach: Content

Maths is taught throughout, using an approach that sees children move from a play based use of practical materials, through to visual modelling and recording, and finally abstract recording.

Number and calculation

The school has its own clear progression document for teaching number and calculations which teachers use to plan learning. It emphasises developing understanding through the use of practical materials and models and images including Numicon, number lines and hundred squares. A clear understanding of place value and ordering is seen as essential to ensure children are able to understand calculations. This starts with the youngest children; when the register is taken for two year olds, the adults and children count the number of children in the room and check using pieces of Numicon placed around the room. In KS1 classes, children are encouraged to draw bank number lines and sections of hundred squares to help with calculations. The registration process also supports this. Three year olds are registered through a number line on the whiteboard; they are frequently asked during this process 'how many are ticked off?'. They also check through the use of Numicon.

Interventions

For children who need extra support, a range of strategies are used. These include a Numicon pack being

given to parents to work through with their child. The class teacher or the maths co-ordinator shows the parents what to do. Misconceptions identified in lessons are addressed within the lesson or addressed in a one to one with their teacher, teaching assistant or with the maths co-ordinator. Sometimes the maths co-ordinator will have two or three short sessions with a child who needs more support.

Pedagogy

There is no set time in the school day for teaching mathematics and there is no set pattern for a maths lesson. Some sessions will start with whole class teaching, where children go off to work more independently or some will work in an adult supported group. On other days, a range of curriculum learning may be taking place concurrently. This may include an independent maths learning task with colours or shapes used to help children identify which task(s) to carry out.

Children may work in small ‘ability’ groups with an adult to consolidate or move them forward in that particular area of maths learning.

The school often has themed problem solving activities for children. Recently, the theme was pirates and children had to consider the story of a pirate who started with 39 gems and ended up with only 16 gems. Another problem solving outdoor activity is that of collecting a set number of twigs, some of which are the same size as ‘your’ hand, others smaller and others bigger; after, children sort them into sizes.

Teachers will often use games to support the children’s learning; for example, using dice to add one number to another.

Across the school, children enjoy the practical side of maths, which is always set within a ‘real-life’ context.

Grouping

In the Early Years Foundation Stage children are rarely grouped for maths with individuals accessing their own learning or being called to adult directed tasks at various points across a week.

The grouping of children in KS1 is flexible. Teachers plan on a daily basis, working from a medium term plan and their reflections on how children have learnt the day before.

Assessment and planning

The planning process in the school can be simplified to:

- This is where the children are.
- These are the National Curriculum targets.
- These are the resources I use to best support children’s learning.
- This is how the day will need to be arranged to enable all children to learn.
- This is the language the children will need.

During planning sessions, teachers identify where maths can be included across subjects. For example, if children are going to look at measures in science, the teacher will ensure that children have already covered

this topic in maths. Teachers from each year group do their planning together; the maths co-ordinator contributes if she is asked. She has a good overview of children's progress across the school, both as maths co-ordinator and SENCO. She monitors children's books weekly and regularly looks at their books in class on a more informal basis. There is a culture of professionalism across the school.

Learning Journeys are used throughout the school for children. Children are regularly observed and photographs of their learning and/or any independent recording are used to build a picture of the child's learning.

In the Early Years Foundation Stage children are assessed against Development Matters phases. In the Summer term of the Early Years Foundation Stage Two (EYFS2 / Reception) the assessment is the EYFS profile.

All children are given regular feedback as they work. This is based on a star system (one star, two stars and a wish) - extend, consolidate or address misconception. From EYFS2 onwards this is in written format as well as being shared verbally with the children.

Parent engagement/home learning

Once a year, the school organises a session for parents on 'how to support your child with mathematics'. A booklet on supporting mathematics is provided for parents on the school's website; the accompanying commentary is very clear about the importance of positive attitudes to maths: 'maths is part of everyday life and we can all support our children by fostering a love of mathematics and helping them practice counting and the ability to quickly recall number facts'.

A half termly newsletter keeps parents informed about what their child has been doing in maths and what they will do in the future. In addition, termly reports and parent consultation, along with the school's open door policy, ensures parents are well informed.

Improving children's outcomes in maths: Key to success

- **Staff are enthusiastic and confident teaching maths.**
- **Maths is practical and exciting.**
- **There is excellent marking and feedback which ensures children are engaged in well-matched challenges.**

Looking to the future

Monitoring teaching and learning, including through tracking pupil progress, are key activities for even further improvements.

Children's Centres: Redcliffe Nursery School and Children's Centre, Redcliffe, Bristol

Why children at Redcliffe Nursery and Children's Centre do well in maths: Key statement from the head teacher:

"The mathematics is open and not restricted to numbers 1-10 or the four basic shapes. It is about working from whole concepts and not step by step procedures. It is also valuing what children bring to the learning and giving children exciting mathematical opportunities".

Key data

97 children age 3-4 years (with 140 children on the register)

40% of children are disadvantaged

70% of children are EAL

15% of children are SEN Support

There are 26 members of staff including eight teachers and two with Early Years Professional Status (EYPS).

55% of staff hold degrees.

Eight members of staff hold post graduate qualifications including Masters and one is studying for a PhD.

All staff are qualified beyond Level 3.

Staff are encouraged and supported to study for a Masters if they don't already have one.

Key performance data

85% of children have achieved beyond their expected age in maths in the last five years.

Context

Redcliffe Children's Centre and Nursery, situated in one of the 30% most deprived neighbourhoods in England, became a National Teaching School in March 2013; it was one of the first nurseries to be given the award. Situated close to the centre of Bristol, Redcliffe provides education for a very international community; on average there are 12 languages spoken across the setting. In the last eight years, it has been judged outstanding by Ofsted at every inspection (nine in total). A local authority children's centre, it is open 48 weeks a year and provides outreach for 1,400 families.

As a teaching school and a research base, there is a strong focus on professional development. The head of the centre leads research both across the setting and across Bristol. She is a maths specialist, with a Masters in Early Years and Mathematics and is currently studying for a doctorate in the same subject area. She was the first, along with her colleague, to coin the term 'children's mathematical graphics' (Carruthers and Worthington, 2003), to describe children's written representation of their thinking during maths activities.

Approach

Redcliffe has a policy of ‘open maths’ - that is, opening up enquiry. This applies to staff and children alike, with a strong focus on ‘an immersion in maths’. Staff often display data from their action research projects - simple graphs or tallies - which are discussed with the children. **The approach to maths at Redcliffe is informed by research and integrated into practice through a culture of continuing professional development.** For example, evidence encouraged the head to consider how the physical environment could better support maths development. It has now been adapted to address the wider aspects of maths like ‘positional language’ - under, over, between, etc. Maths displayed around the building - numbers, tallies, graphs, children’s maths markings and a clock - all contribute to the strong maths culture which has developed at Redcliffe. The ‘wholeness’ of maths is further promoted across the setting, with maths dictionaries in every room and an ‘infinity wall’.

As leaders of Bristol Early Years Mathematics (through the Teaching Consortium), **Redcliffe has developed a framework for practice which is employed or being developed across the consortium.** This includes: problem solving at the centre of maths; children leading their own play; adults listening to children; maths in a meaningful context; modelling of mental calculations; counting in different ways in a meaningful context; valuing children’s graphics and understanding the thinking behind it and use of ‘real life’ resources.

Content/Pedagogy

Maths, taught in themes, is threaded through the day; there is a big focus on maths graphics and maths marking. Where possible, the setting connects with what the child has done at home and tries to build on that. Exploratory play is a common activity, enhanced through the mathematically rich environment, indoors and out; for example, children chop food in a blender, using different speeds.

There is an emphasis on listening to children and what the practitioner does with that after. Children’s communication is very important and adults pay particular attention to understanding how the child is communicating with them - what are they saying, what do they mean and how do you as an adult respond to that?

Redcliffe promotes children talking about maths and talking through ‘problems’. For example, during snack time, the practitioner will say: ‘I only have one banana today between all of us. How am I going to divide that up?’ Both children and adult questions are valued at Redcliffe. Their relevance in problem solving is clearly understood by all staff. Children use maths a lot at meal times; for example, when setting the table and counting the knives and forks. During cooking sessions, children have opportunities for weighing, measuring and discussing that. Numbers - addition, subtraction, multiplication and division - are further developed through stories and rhymes. There is a strong focus on calculation, of which counting is a big part. Calculation is developed through: children’s own methods (for example using objects); teachers providing/ responding to problem solving activities; children recording with abstract symbols/numbers; building on children’s knowledge; frequent use of the language of calculation (for example more, how often? etc.) and the ‘calculation environment’

Planning and assessment

Maths plans are drawn up on a monthly basis, with staff working in groups of three to four to do this. Key mathematical concepts, for example, over the area of calculation, are underlined, and collective consideration is given to how they can be addressed in practice for different children.

Observations, based on children's development over the areas of number, shape and space and measure are recorded in children's individual learning diaries. This particular approach, details of which are shared with parents, ensures that the key person regularly reflects on children's mathematical development; this informs planning for children's 'next steps'.

At Redcliffe, children work in key groups with a key adult. This enables staff to know the children well and enhance their development; for example they can quickly make links with mathematical language or symbols. This is further supported through working in designated areas, which each key group 'owns' and develops. Resources in the area - 'maths boxes' - include such things as builders-spirit-levels, which provide opportunity for the development of children's higher level thinking. As their understanding increases children will add their own resources. In addition, they have the freedom to move the resources around the room adding to their feeling of 'ownership'. To ensure that opportunities for maths are not missed, planning includes the development of an 'environment plan', where all environment plans incorporate number.

Parent engagement/ homelearning

Regular informal discussions between the key person and the child's parents, enable parents to enhance their children's home learning experiences.

Staff Training

As a research base, staff development is seen as a priority, supported through teacher/practitioner research. Staff are given individual professional development time. The head of the setting, who leads staff development, is constantly involved in training. Every member of staff has a mentor and staff are encouraged to talk through the maths - 'voicing it yourself is the best way to learn'.

The head believes it is important to develop practitioner subject knowledge, within the context of working with children. She tries to develop an awareness of maths and using maths. Many practitioners will say 'I didn't know that was maths'.

Staff are at different stages in their development; so if something is not happening in practice, the head will try and stimulate that.

Improving children's outcomes in maths: Key to success

- **A culture of CPD, coupled with staff research, ensures that practitioner subject knowledge is developed in the context of working with children.**
- **A mathematically rich environment developed to enhance exploratory play.**

- Maths is weaved throughout the day and is not an 'add on'.
- As soon as the children enter the nursery they are engaged in mathematics that is relevant and purposeful.
- Children are challenged in their thinking as the maths curriculum starts with enquiry and problems solving.
- The key person knows the children's mathematics from home and extends the possibilities.
- Children are viewed as knowledgeable learners capable of great things.
- Children are given opportunities to use a variety of strategies to solve problems including developing their own mathematical graphics.
- The teachers and practitioners have good mathematical subject knowledge and model appropriate vocabulary.
- Teaching is not about asking direct questions but co-constructing understanding about the problems.
- The learning diaries are a collaborative learning tool that the parents, child and practitioner learn about the maths that is happening in school and home.

Looking to the future

As a teaching school, Redcliffe wants to further develop their Bristol Mathematics Strategy for early years, particularly influencing Reception and Year 1 classes in primary schools.

Children's Centres: Thames Children's Centre, Blackpool

Why children at Thames Children's Centre do well in maths: Key statement from the manager:

"The development of staff maths skills through the Maths Champion programme, staff making maths fun and staff playing with children to support their development".

Key data

54 children a day, ages 0-5 years

64% of children eligible for 2-year funding

42% of children are Early Years Pupil Premium

11 children are EAL

3 children are SEN Support

Situated in Blackpool in one of the 10% most deprived neighbourhoods in England, this SureStart Children's Centre serves its children well. The centre has three rooms: a baby room with up to six babies a day; a room for two to three year olds, with up to 16 a day and a room for three to four year olds, with up to 32 children a day. The eleven members of staff have varying qualifications; one member of staff has EYPS, two have EYTS (one is the manager), whilst the others are qualified to at least Level 3.

Context

The manager took up her post at Thames Children's Centre in January 2016. Her first step was to make a number of changes in maths. At the Centre, each member of staff has a project to work on; the manager's project is currently that of developing maths for three to four year olds. Her research highlighted the NDNA (National Day Nurseries Association) Maths Champion programme. She joined along with six practitioners from the setting.

Initially, some staff were hesitant about signing up for a maths programme which also involved taking on-line baseline tests; some had negative attitudes towards maths. But the baseline assessment gave each person targets to work on over an eight-month period. The manager gave staff time to do this and many would just sign on at various quiet moments during the day. As they progressed through the course, there were regular meetings with all staff in the setting to pass on subject knowledge and examples of good practice.

The development of maths was also supported by the settings participation in the REAM (Raising Early Achievement in Maths) initiative in Blackpool. The overarching aim of REAM, was to show that maths is in every-day life and maths is 'real'. As the manager says, 'to show parents that maths is not just about algebra'. Families engaged well and learnt about maths by watching the staff at Thames Children's Centre.

.....

Approach: Content

All children, from 0-5 years follow the EYFS framework at Thames children's Centre. Maths focuses on number, shape, base and measure. Some practitioners were already doing this when the manager started at the centre, but weren't necessarily recognising it as maths. Numicon, which the manager considers good for developing children's visual sense of number, was already being used across the setting. Numicon resources are in all the rooms, which provides continuity for the children; many use the plastic resources for play.

Pedagogy

The setting focused on finding opportunities for maths through play; for young children a lot of learning is done in this way. Adults in the setting follow children in play and consider their interests. Children are observed and planning is done around the interests of the individual child. Children naturally enjoy counting and sorting and love to achieve. To this end Thames Children's Centre developed maths activities around these areas. The setting makes maths 'real' and is good at supporting the children to develop independence; this is enhanced through problem solving. For example, children get their own knife and fork for lunch, they also get their own food and must follow simple instructions, 'two pots or one sausage'. It provides a way of checking children's knowledge and understanding.

Staff training

Doing the Maths Champion programme has provided a very good way for staff to develop their own practice and improve their maths skills. The fact that training is delivered as an online programme gives staff a lot of confidence. They can dip in and out of the programme during their daily activities; the result is that many don't notice that it is maths.

Situated in Blackpool, the setting benefits from termly training provided free by the Local authority. In addition, the manager attends Early Years Blackpool Network meetings every 12 weeks, which focus on sharing good practice, moderation cluster meetings every six weeks and termly Manager Cluster meetings with local authority representatives present.

Assessment and planning

Across the setting, practitioners plan for each child's learning. There is always a focus on where maths can be addressed. If children are not making expected progress after a few weeks, the manager will look at the observation notes of the child during this period to see if an opportunity has been missed. For each child, a member of staff will do two 'post-it-note snapshot' detailed observations per week. The details are recorded in the child's learning journal, which is linked to the EYFS Tracker. A summary form is produced which children take home for their parents to add comments.

Parent engagement/ home learning

The setting has home learning bags and bath bags (toys to use in the bath). Children take each bag home once a week. There are instruction sheets showing parents what children can do in numeracy and literacy

and how this can be further developed at home. Parents comment on what their child enjoys.

Improving children's outcomes in maths: Key to success

- Development of staff maths skills through the NDNA Maths Champion programme.
- Staff making maths fun.
- Staff playing with children to support their development.

Looking to the future

The manager believes there is always room for improvement and highlights the following as areas for even further development:

- Ensure staff keep focusing on making maths fun.
- Focus on staff playing with children to support their development.

Nurseries: Bottesford Bunnies Pre-School, Scunthorpe, North Lincs

Why children at Bottesford Bunnies do well in maths: Key statement from the manager:

“Making maths fun, engaging and exciting”.

Key data

33 children for each session (maximum), ages 2-4 years

9 children eligible for 2-year funding

42 children are eligible for 3-4- year funding

1 child is eligible for EYPP

1 child is EAL

12 children are SEN Support

There are eight members of staff, including the manager, with a L6 qualification and Early Years Teacher Status; she also completed a five-part (John Pearson) Mathematics training programme organised by the LA. Six members of staff are qualified at Level 3 and two at Level 2.

Situated in one of the 20% least deprived neighbourhoods in the country, Bottesford Bunnies has seen significant improvements in practice in a short period of time, particularly in maths. In 2014, Bottesford Bunnies was rated outstanding by Ofsted; at its previous inspection in 2011 it had been rated ‘requires improvement’.

Local ‘feeder’ primary schools have commented on the children’s good knowledge and understanding of numbers. Transition of children to primary school is important and in October each year, the manager visits the main primary ‘feeder’ schools to find out how their former children are progressing.

The nursery welcomes children Monday to Friday, term time only.

Key performance data

In autumn term 2015, 36% of the boys were at the expected stage of development in maths, with 58% of the girls at the same stage. At the end of the academic year (summer 2016), 64% of the boys were at the expected stage of development, with 75% of girls at the same stage. It should be noted that new children started pre-school throughout the current year.

Context

Bottesford Bunnies aims to maximise the opportunities it provides for all children, with maths practice evaluated through the ECERS 3 rating scale.

The manager attends early years teacher/professional network group meetings termly in which good practice is shared; and in her part-time role for the local authority as an Early Years Development Officer, she shares good practice in mathematics with other early years providers in the PVI sector. Recently, the manager delivered a good practice workshop on Talking and Thinking Floorbooks to other providers and showed how maths can be incorporated into this. The Early Years Development Officer provides support and guidance to the setting as needed, including offering further ideas and suggestions.



Approach

Changes in maths were purposeful and made in 2015; these were initially identified through cohort tracking data and practitioner concerns that their key children were not showing an understanding of maths. The manager studied the progress of children across all areas of the EYFS and found a gap in maths: 'children were not getting number'. In May 2015, the setting made a focused improvement plan outlining mathematical actions. **Being part of Achieving Early enabled the setting to have a stronger focus on maths strategies and interventions for the most vulnerable children; this has had an impact on outcomes for all children around maths.**

Following a staff survey which showed many had negative experiences of maths in school, the manager gave careful thought to the language used for maths and the particular training approach.

Changes

An initial audit of resources and the environment highlighted a lack of provision around shapes.

To address the gap, the setting purchased shapes; examples included carpet tiles imprinted with circles, triangles and squares. These have enabled the setting to develop a more interactive approach: children will play a game adapted from musical chairs called 'musical shapes' moving from a circle to a triangle, or a game of corners in which they decide which shape to go to when the music stops. Practitioners will use the shapes as part of an obstacle course, jumping on a triangle or a square.

This activity has been particularly good for boys; it encourages their engagement and enjoyment. Shapes are also used to make pictures, along with children identifying numbers by making a mark or equally identifying a particular shape. Shape apps and games have also been purchased for the ipads the children use with practitioner support.

Content

Maths focuses on numbers, addition and subtraction. Close daily assessment involves regularly checking that children can move from numerical to quantity. For children who take longer to grasp a concept, their understanding is developed through a different approach. For example, using a pile of toy cars, a practitioner might ask 'how many cars do you think we have?'. If there is silence the practitioner might say '1, 10, 100, etc.'. When the child has responded, the practitioner might say 'ok let's count them'. This is part of children learning to estimate: age 40-60+mths. As the manager says 'it is finding a way to move them on in their learning, when they are ready'.

Pedagogy

At the end of sessions, children tend to work together in small groups; free play for children is self-selecting. Children love number hunts, where they look for a themed number or shape hidden in the room or the outdoor play area; when it is found the child calls out the number. One week there was a focus on transport, another week the focus was around 'people who help us', and number hunts involve looking for cards 0-20 with pictures of different types of transport or different people who help 'us'. When all the children have found all the cards, time is spent ordering and sequencing the numbers; for example, children might be asked 'what number comes after...?'. Other games include hopscotch, dominoes, using shopping baskets and items, sinking and floating, skittles, puzzles, etc. **Problem -solving is also important and is addressed according to the child's development.** An example might be playing with sand and water, where a two year old will fill a bucket with sand and find it too heavy to lift. The child might say 'I can't lift', the practitioner will respond by saying 'it's too heavy' and show them; they then ask the child what they are going to do about it. The child might say 'take some out' and the child might turn the bucket over to remove some sand. A four year old might say "I need some help as it's too heavy" and the practitioner may reply "what do we need to do?". This helps the child to problem-solve and come up with a solution; for example, to hold the bucket together to turn it over.

Children learn numbers by looking at photographs with numbers or houses with numbers in order to see numerals in the environment. Or a practitioner might say 'what number shall I put into my mobile phone?' **Wherever possible, there is a focus on numbers in 'real-life'.**

Staff training

The manager provided in-house training for all staff. The focus was on modelling and demonstrating how they could use maths. Initially staff were asked to record opportunities for maths on large sheets of paper placed in each area of the room. The manager gave examples covering areas such as snacks - 'how many spaces at the table' - that is maths. Staff, were encouraged to develop this approach with all children; for example, 'how many plates are missing?' And, 'is the jug heavy or light?' With each area, the manager and the staff highlighted missed opportunities for maths and different examples of mathematical language that they could use and model for the children.

On-going staff CPD provided by the manager includes maths peer observations and training; the latter is often based on a recent journal article and moderation of children's observations during team meetings.

Assessment and planning

The key person, who has responsibility for up to 10 children, will closely monitor their children's progress. Quality checks are carried out termly by the manager on a sample of two or three files; these are linked to assessments. The tracking system has a number of sub levels allowing incremental steps of progress to be monitored. The deputy manager, liaising with the manager, in compiling the tracking data, will also quality check the accuracy of assessments.

Parent engagement/ home learning

Parents are keen to engage in their child's learning and when children are doing topics in nursery, related activity/interactive sheets are sent home asking parents or carers to support and consolidate their child's learning; examples might include a shape hunt around the house. Number activities are also sent home. Chatter packs and story bags have a maths focussed activity for the children to do with their parent or carer at home. For example, in the Jack and the Beanstalk story bag, different sized laminated beanstalks are included for the children to sort according to size.

Improving children's outcomes in maths: Key to success

- **The manager's knowledge and understanding of maths, developed through maths courses; she knows what the children need to know.**
- **Staff development (in-house) by the manager and the deputy manager attending Maths SSTEW training (sustained shared thinking and emotional well-being) delivered by Denise Kingston (UCL Institute of Education).**
- **Making maths fun and engaging.**
- **Knowing each child well and how to further develop their understanding.**

Looking to the future

- **'We constantly shine and we want to do even better'.**
- **Maximise children's opportunities for working with practitioners.**
- **Explore using Numicon.**
- **Develop a new focus on planning; look (what are the child's interests, what works and what doesn't work); listen (how is the child supported in the activity?); note (what can I do next time and why?), incorporating maths.**
- **To moderate observations with feeder schools (to include observations on maths).**

Nurseries: Flutterbies Nursery, Rotherham

Why children at Flutterbies Nursery do well in maths: Key statement from the manager:

“Good adult interaction with the children and the opportunities they provide - then the children make progress....it’s about making maths fun and challenging, but not too challenging”.

Key setting data

32 children for each session (with a total of 50 places), ages 0-5 years

12 children are eligible for 2-year funding

20 children are eligible for 3-4- year funding

Context

Flutterbies, 10 miles from Rotherham and situated on a small industrial estate, serves children from one of the 20% most deprived neighbourhoods in the country. The manager has worked in this position for 11 years and recently became the owner; she has Early Years Professional Status (EYPS). There are 14 members of staff at Flutterbies, all with a minimum of Level 3 qualification; one member of staff also has EYPS and one has QTS. Flutterbies is open Monday to Friday all year.



Approach

The manager made the changes about nine years ago. She wanted the children to develop their conceptual understanding in maths. Previously children would sit on the floor and use worksheets; maths had little meaning for them. When the changes were made, the manager wanted to put maths into every-day activities.

Changes

The manager considered both the EYFS framework and recommendations from the previous Ofsted report to develop daily maths activities and increase the profile of maths across the setting.

Content/pedagogy

Currently, there is a strong focus on number recognition. There are number lines around the rooms and outside and staff count the children through the door as they come into the room. For indoor play, there are a number of Bee Bot electronic small toys, for example a yellow and black bug. These can be programmed to take a number of steps forward and back. For example, objects are marked on the floor - a star, a house etc - and a member of staff will say to a child ‘let the bug go from the star to the house. How many squares has it moved forward?’

There are many opportunities throughout the day for children to consider number and the concept of numbers. Examples include, children helping staff to lay the table for lunch. A practitioner will say 'there are six today and I only have four plates, how many more do I need?'. There is a water tray in the room, with numbered fish (1-20), and children count the fish. Other activities include sorting and counting coloured buttons, games, including dominoes with numbers, colours and dots.

A weather board is on the wall in each room. Every day staff will discuss with the children the day of the week, the date and the daily weather report. A lot of use is made of the interactive whiteboard. For example, practitioners will consider a trip to the vet and how much it might cost and how much money children have. Similar activities relating to money might include a role play at the shops or similarly a visit to the hairdressers. **Staff try to make maths fun, with the result that children enjoy it.**

Staff training

The manager encourages staff to take responsibility for their own CPD. The local authority provides a number of courses, from which staff select the courses they would like to attend; these are funded by the nursery. The manager uses the online training provided by the NDNA and PACEY; she finds these helpful. She often refers to Facebook which she finds useful for good practice examples.

Assessment and planning

Children's progress is closely monitored through observation. There are longer more detailed observations of children, two every month, and 'snapshot' observations at least once a week. Observations are linked to the EYFS and recorded as a child's profile. Children are assessed against Development Matters. Planning is done on a daily basis to respond to the child's next steps.

Interventions

Flutterbies does not use external or commercial interventions. If a child is behind, the child's key person will record this using dots on an electronic tracking system. This is analysed, staff then meet to identify the child's area of need and work out a programme of activities to enable the child to make progress. Children's progress is reviewed frequently by the key person, with formal reviews three times a year.

Parent engagement/home learning

Flutterbies was involved in the pilot of Every Child a Talker; although it focuses on literacy, there are many references to maths - shape, size and numbers. Being involved in the pilot helped the nursery to better engage parents in their children's learning and development. Story packs were available for parents to take home and use with their child; these were very popular. Flutterbies now continues this approach; for babies there are 'treasure bags' to take home.

Improving children's outcomes in maths: Key to success

- Good adult interaction with the children and the opportunities they provide.
- Making maths fun and challenging (but not too challenging).
- Bringing maths into day to day activities.

Looking to the future

- Continue to look for new opportunities for children and staff.
- Continue to change resources so that staff are not bored.
- Build on the already good staff interaction with children.

Nurseries: Little Owls Nursery, Scunthorpe, North Lincs

Why children at Little Owls Nursery do well in maths: Key statement from the manager:

“We look at each child’s individually and focus on their interests, to help with their development”.

Key school data

31 children for each session (maximum), ages 2-5 years

29 children eligible for 2-year funding

33 children are eligible for 3-4- year funding

19 children are EAL

1 child is SEN Support

Little Owls has 15 members of staff, all with varying levels of qualifications; two members of staff have early years professional status, three hold foundation degrees, 11 have early years qualifications at Level 3 and one holds a Level 2 qualification. In 2013, Little Owls, which is open every day except bank holidays, relocated to its current site and re-registered.

Transition to primary school is important and the manager has built good relationships with the local primary schools and the special school. Every October, she visits the local schools to find out how the children from Little Owls are getting on.

Context

Situated in one of the 10% most deprived neighbourhoods in the country, Little Owls was rated outstanding at its last Ofsted inspection in 2013. The manager, with early years teacher status was a maths regional lead in Lincolnshire and in 2013/2014 undertook the NDNA Maths Champion training.



Approach

The setting aims to involve all children every day. This has brought a big focus to the physical environment and how maths can feature everywhere. There are shapes around the room, on the floor, on walls, etc. To stimulate children, a member of staff might say ‘find a circle’. The approach in the setting is whole group, with two and three year olds working more closely with their key person and being registered separately. Interventions are used when needed, with a focus on both catch-up, gap-filling and providing challenge to more able children.

Changes

The manager made a lot of changes in maths practice and approach when she joined the maths champion training; this provided the opportunity to reflect and evaluate practice through the

sharing of ideas. At Little Owls, there is a lot of adult interaction with children. There is a big focus on number and measuring is a daily activity, with children using measuring scales. For lower ability children measurements are made in the context of size - bigger/medium/large - and jig-saw puzzles will be larger.

Content

Maths is fun at Little Owls and children learn through games, which include counting dots, covering dots, matching dots and matching the colour of the number to the colour of the dots. For higher ability children, there is a focus on number recognition and using Lego to develop three dimensional shapes. Games are considered important for children's development in the early years, along with problem solving. Simple problem solving includes supporting children in working out the number of planks needed to build a construction during outdoor play.

Pedagogy

The manager highlights the centrality of knowing all the children, their strengths, areas for development and challenges. This provides the key to enabling them to advance in their learning and development: '[Knowing the children enables us to find something they can do. It might be a game and it gives them confidence. They may do a little bit and come back to it again. Each time they can do a bit more and grow in confidence](#)'.

Through the Achieving Early programme, which Little Owls joined in 2015, there has been a concentrated focus on communication – children, parents and between staff. Across the setting more time is spent chatting to children as they are doing activities, listening to what they say and responding with useful comments or prompts. This interaction with staff, is enabling the children to move forward better in their learning and development. Further stimulation is provided through the on-site library in the building next door, which small groups of children visit regularly.

Staff training

The manager provides regular training to staff, who identify (in discussion with their manager) further LA training they would like to attend.

Staff are good at thinking outside the box to provide the right support, guidance and stimulation for children identified as SEN. For example, there is a system of tubes and cars and games with numbers and dice. There is a big focus on the integration of children's personal and social development alongside their day-to-day activities.

Assessment and planning

Children's progress is closely tracked, which enables staff to quickly identify gaps and strengths in children's learning and better support their learning and development in new areas. Children are observed on a daily basis, with details recorded on a tracking form.

Parent engagement/ home learning

The setting uses Tapestry, an online system for sharing observations with parents. Parents can add their comments at home; with most parents working, it can be difficult for the setting to find a time when they are free to come in. A recent grandad and dads morning, where they spent time with their child doing crafts and reading, was very successful. For parents whose first language is not English, individual words are highlighted on work sent home.

Improving children's outcomes in maths: Key to success

- **Managers good knowledge and understanding of how children learn and develop in maths - enhanced through further qualifications and training (NDNA Maths Champion training).**
- **Through in-house training, the setting has taken maths away from the table and made it fun and accessible to all. This is achieved by using size, measuring and quantity with simple cause and effect science experiments and using maths in all areas inside and out.**
- **Maximising adult interaction with children by talking and listening and waiting for a response at the child's level.**

Looking to the future

To enable children to better understand time.

Childminders: Amanda King, Childminder, Mitchell, Newquay, Cornwall (Lollipops Childcare)

Why children do well in maths: Key statement from the childminder:

“Children enjoy and make good progress in maths as they learn in a natural way. They are encouraged to discover numbers, explore shape, space and measure through carefully planned activities and opportunities within the environment”.

Key setting data

9 children (with maximum of 25 children on roll)
Ages 0-4 years (currently the youngest is seven months)

Key performance data

Records are kept for individual children, but are not available for the group.

Context

Lollipops childcare, situated in the small village of Mitchell, near Newquay, was rated outstanding by Ofsted at its last inspection in June 2016. Registered since 2008, the childminder works with two assistants; all hold a Level 3 qualification in childcare. **The staff at Lollipops know the children well and focus on building on their previous learning.** Staff training is important. The childminder attends peer network meetings and regularly works with other childminders to share good practice. Her assistants are well supported in their professional development and are encouraged to reflect on their own practice in the context of the children’s learning. **The childminder works closely with local primary schools and supports children well during the transition from the setting into school.**



Approach

Maths is integrated into daily learning activities at Lollipops. The setting follows the EYFS framework, weaving maths across all areas. There is a whole group approach, with activities adapted for children of different ages and stages.

Changes

After evaluating children’s achievement and focusing on maths as an area for improvement, the childminder made a number of changes. Her initial focus was the environment and how it could be adapted to raise children’s awareness of maths. To this end she displayed numbers on bunting and posters indoors and out, placed at a low level for children to see. She also introduced number activities to ensure

that maths would be fun and exciting for the children. For example, a number treasure hunt in the garden, numbers to explore on the light table, and opportunities for shape and pattern exploration.

Content/pedagogy

Maths is based on a Kinaesthetic learning approach. That is, children becoming engaged in maths by experiencing it within the environment. This is further developed through number songs, and using scales and pretend money in role play. Maths focuses on numbers, counting, weights and measures, grouping, sorting and patterns. The childminder acknowledges the importance of developing maths within a 'real-life' context: 'all maths learning is real as the children are pre-school aged; this is the most effective approach for this age group'. Across the setting, maths is developed in a fun way, which motivates children in their learning and development. As a result, interventions are rarely needed.

Assessment and planning

Children are observed regularly by the childminder or one of the assistants. Observations are closely monitored by the childminder which are considered alongside the overall programmes of work. Together with the assistants, the childminder will consider how the children can be moved forward in their learning and development. The setting focuses on building on previous learning and supporting children through the provision of stimulating and fun activities; this enables children to become very independent.

Parent engagement/home learning

Parents at Lollipops are very engaged with their children's learning and development. This is supported through daily feedback from the childminder and being involved in the child's next steps; parents are supported in developing the home learning environment. Parents regularly feedback what their child has been doing at home and any particular interests they have developed.

Improving children's outcomes in maths: Key to success

- **Children enjoying maths.**
- **Children learning maths in a natural way, that is, self- exploratory within a maths rich environment, through carefully planned activities.**

Looking to the future

- **Always look for ways to improve and develop further.**
- **Further develop bringing maths into everyday play, encouraging, supporting and challenging children.**

Childminders: Carolyn Ince, Childminder, Buckinghamshire

Why children's outcomes in maths are good: Key statement from the childminder:

“Making maths part of every day. It is made real...there is no focus on ‘this is maths’”.

Key setting data

21 children age 0-5 years

2 children eligible for 2-year funding

1 child is EAL

Key performance data

Published data is not available.

Success is monitored through the amount of mathematical language used spontaneously, as well as the progress being made in assessment.

Context

Carolyn Ince is a registered childminder in Buckinghamshire. She has run the setting for 17 years and in 2012 attained Early Years Professional Status (EYPS). Based in private premises, Carolyn works with two assistants and looks after children of different ages and developmental need. Some of the children have additional needs, often a developmental delay caused by environmental factors; there are currently four children in this category. Other children, whose first language is not English arrive at her setting with language difficulties. She is open all year, five days a week, 10 hours a day.



Approach

In 2014, the manager reviewed the approach used in the setting for children's learning and development. She believed maths was being taught in isolation and needed a more integrated approach; this contrasted with the approach to language, where day to day 'modelling' was common.

The change was initiated through an evaluation of maths activities across all areas of the early years foundation stage. When the manager initially made the changes, there was some fear amongst staff about maths. But she affirmed the need of not 'making a big thing about it being maths. I just want us to be counting or just looking at the concept more'.

Staff were asked to think of where maths could be addressed; approaching the audit in this way enabled the manager to reconsider the various activity corners and how maths was evident in the environment. Maths is

currently brought into daily activities.

Content/ pedagogy

There is a big focus on number across the setting and an individualised approach to developing children's understanding. For example, one child enjoys playing games. To develop his number sense, there are a selection of dice, some with dots, some with numbers. The child can roll the dice and see what number five looks like.

There are no set times for specific subjects. When a child shows an interest in a resource, the child will generally use it and can be prompted by staff to ensure they get more out of the activity.

Every day a child will have one-to-one contact with the manager. For example, this may be during outdoor activities in the wood and sorting sticks into sizes.

After a maths resource scoping activity, the manager made her own resources. One resource included a series of 11 small boxes, each containing the number of little characters marked on the box; for example, box six contained six toy dogs. Children might play with the boxes, removing the objects and be asked 'how many dogs do you have? So which box does that go into?'. Taking this further, children build short stories around the boxes. Objects are changed regularly.

Staff training

The manager keeps up to date with happenings in maths through her own research and reading and through regular evening meetings with the local EYFS group. The group shares practice and members are encouraged to come up with at least one new or innovative idea. As the manager says, it is never a good idea to say 'I can do maths now'.

Assessment and planning

The manager developed a mathematical journey, allowing staff to change the way they observe children, looking for small steps of progress across counting, comparing, subtraction and addition, etc. For example, if the children are engaging in outdoor activities in the woods, they will gather sticks and count them or compare the length of the sticks and may sort them into length categories.

Parent engagement/home learning

Some parents are very interested in their child's activities. The manager shows them their child's 'mathematical journey' and how they can support that development at home. There is also a half termly newsletter sent home to parents, always with some maths announcement. For example, in winter there is a baking day and the newsletter will refer to how children measured the ingredients and other activities related to that and what the children achieved at the end of it.

Improving children's outcomes in maths: Key to success

- **Manager knowledge and understanding of maths, teaching and learning.**
- **Staff training in maths, ensuring there is no focus on 'this is maths'.**
- **Making maths part of every day.**
- **Making maths 'real'.**

Looking to the future

For the manager, the primary focus is keeping staff well trained. As an adult educator, she trains her own staff. However, she comments on recruitment as the biggest challenge facing the early years sector.

Childminders: Charlotte Greeno, Childminder, Cambridge (city)

Why children's outcomes in maths are good: Key statement from the childminder:

“Making maths as real as we can and giving them the chance to do it themselves; letting them make the mistake and then work it out (solving problems), rather than telling them it's right or wrong”.

Key setting data

Up to six children under eight (of which three may be under three and one may be under one)

1 child is eligible for 3-4 year old funding from January

1 child is EAL

1 child (over five) with formal SEN support

The setting also accepts children eligible for two-year old funding

Key performance data

<u>Age of child (Oct 2016)</u>	<u>Number</u>	<u>Measure and shape</u>
48 months	40-60 months (Developing)	40-60 months (Developing)
25 months	22-36 months (Developing)	22-36 months (Developing)
35 months	30-50 months (Developing)	40-60 months (Emerging)

Context

The childminder spent 11 years working with children, four of these as a registered childminder, and seven years in nursery settings. She believes her experience and ongoing training has provided a strong foundation for childminding. She keeps up to date on maths through a PACEY local group, which meets every week and through a strong network of local childminders, as well as the PACEY Local online forum. She has just embarked on a BA (Honours) in Early Childhood through the Open University, and attends various conferences and talks throughout the year.



Approach

Her approach to maths, as with all areas of early learning, is to talk in the same way to all children, using the same language, vocabulary and concepts, adapting it where needed. She believes that being excited about maths and role modelling excitement about learning is important. She tries to introduce children to as many mathematical concepts as possible. By the time they leave her setting, either to go to a nursery or school, all the children have reached their individual stage milestone. She sees the connection between communication and numeracy: 'if children have difficulty in communicating, they will have difficulty with numbers. I ensure that they become confident communicators'. Maths is generally brought into literacy through story telling or

play; for example The three little pigs.

Content/pedagogy

Children learn maths through play and using resources such as play-dough, cooking, self-service at meal times and tally charts. The focus is on numbers, calculations and problem solving. All children follow the EYFS. To promote number literacy, children are encouraged to look at books which include numbers and other numerals within the environment; for example door numbers and car number plates.

Young children tend to 'mark make' in maths rather than write. For example, the number of woodlice seen during an outdoor activity will be shown as marks or a tally. At other times, they will count aloud, for example counting the number of birds in the garden. If children are doing a measuring activity, using weighing scales, the childminder will prompt them to compare weights of objects or if they are weighing pasta, children count the number of pieces of pasta. For younger children she might say 'which is heavier or lighter?'. Older children use measurement for weighing.

The focus on 'real-life' is continued through activities such as visiting the local shop. Children prepare a shopping list before and are given money to do their shopping. The childminder will ask them questions like 'do you have enough money?' or 'do you need more?' or "how much do you predict it will cost?".

Maths is brought into daily activities at every opportunity. For example, using resources as an aside, asking children to count the number of fish in the pond or looking at digital numbers on calculators. Children engage with number work, which is reflected in their comments. For example, they might say 'it is too high' or equally respond correctly to a question about an object being 'too high'. Times tables and formal maths teaching are not a focus in the setting, but children are taught the meaning of bi-cycle (meaning two) or tri-cycle (meaning three). All learning takes place from first hand experiences and play.

Assessment and planning

The setting uses the EYFS Framework to guide planning and activities. Observations are recorded on an electronic learning journey system, which works alongside the EYFS and Development Matters. For example, the childminder might plan a weighing activity for one child. All children will participate, but they may all achieve different aspects of learning. If a child needs support, another activity will be planned. If there are concerns about the child's learning and development, the childminder will speak to the parents.

Children are observed once a week; their progress is assessed against their previous development and Development Matters. The extent to which a child has learnt a concept can be seen in their next steps and the way they use that in their play.

The Cambridgeshire County Council Tracker is used to monitor their progress. This allows a child's learning journey to be tracked by age and stage and feeds into the development of next steps. Additionally, it provides a way of monitoring both individual children and groups of children.

Parent engagement/home learning

The child's learning journey is available securely online for parents to look at. They can look at observation notes and photos, with links to the curriculum and make comments. Parents are also encouraged to upload their own observations from home. There are additional activities for them to do with their child if they wish, which are accessed through a drop box account. If they make comments then the childminder incorporates it into the child's learning.

Improving children's outcomes in maths: Key to success

- Practitioners good knowledge and understanding of how children learn maths, supported through her own studies and engagement with research evidence.
- Setting maths within 'real-life' contexts.
- Giving children the chance to do it themselves; letting children work out what to do if they make a mistake, rather than telling them immediately.
- Supplying children with the tools to solve problems, such as grit and determination.

Looking to the future

- The childminder is always ready to make any changes which enhance children's outcomes; engagement with her degree programme and research evidence she studies provide a good foundation for identifying areas for further improvement.
- Self- evaluation and reflection on how the setting is delivering the EYFS and maths opportunities are helpful in creating a rich child- led environment.
- Continually networking with parents and other professionals to improve setting and outcomes for the children.

Childminders: Sue Smith, Childminder, Ely

Why children's outcomes in maths are good: Key statement from the practitioner:

“Keep your own awareness and be aware of where children have gaps. It is important to identify where the child needs the support. It is easy to see this when you are working with them in small groups. and if they are not interested in something then you need to tweak practice and make it interesting for them”.

Key setting data

9 children currently (1,6yr old; 2, 5yr olds; 1, 3yr old; 1, 2yr old; 1,1yr old and 3, under 1years old)

1 child is eligible for 3-4- year funding

Context

The practitioner had worked for 16 years as a childminder. In July 2015 she interrupted her childminding career to carry out a research project for PACEY. She left with an outstanding Ofsted grading in June 2015 and re-registered as a childminder in August 2016. Situated in a rural area about one and a half miles from Ely, the practitioner also works with children and families during transition to one of the local primary schools. As the PACEY Local Facilitator for Cambridgeshire, she has a lot of contact with other childminders and is involved in arranging opportunities for childminders to keep up to date with maths practice and pedagogy through twice termly 'community hub' sessions. At the meetings, each childminder takes their turn in providing examples of best practice linked to a topical theme. Topics include areas such as observation/planning.



Approach

Maths is addressed through play and integrated into day to day activities. There are frequent maths exercises, for example counting and threading beads. Making the changes has given the practitioner a greater awareness of building simple everyday maths into activities. Children's learning was supported by using the NCB's initiative REAM (Raising Early Achievement in Maths).

Content/pedagogy

As with many early years settings, maths is rooted in play and activities are set up so that children can engage in areas they enjoy. The practitioner focuses a lot on communication and literacy of which maths forms an integral part. Activities are always adapted to fit the needs and interests of the child. For example, for a child who needs more support with counting, she will use a game they enjoy or make flower prints from plastic cotton reels and ask the child, 'how many petals do you need?'

The practitioner is clear about the importance of maths being fun or enjoyable: ‘If a child does not enjoy counting, it must be brought into something they enjoy’.

All children, of differing ages, tend to play co-operatively, with activities being adapted to make them more accessible for the younger ones. For example, the nine month old child engages in making vegetable soup through the interaction of the practitioner with her. The practitioner will hide two pieces of cut vegetable in her hands; she will open one hand and say ‘one’, then the second hand and say ‘two’. The one-year old will contribute to the conversation and the handling of ingredients. Older children will count the vegetables, sort them into bigger or smaller groups, weigh them and sequence them into varying sizes. During these exercises the practitioner is constantly talking to the children and asking them open ended questions about number and size.

Sand and water is another activity used to develop children’s concept of size. For example, a child will put handfuls of sand into a jug, and the practitioner will ask: ‘shall we find a cup to fill?’ or ‘will that fit into a cup?’. Or she may ask: ‘can you add water to the top of the jug?’ and/or ‘can you fit water in as well?’.

Assessment and planning

Planning is done within the context of the EYFS framework and the practitioner keeps a sharp focus on meeting the children’s developmental needs. Development Matters is used to assess children’s achievement in maths along with the other six areas of learning. A baseline assessment of the children is carried out on entry to the setting. This is often informed by what the parents say. Children are observed daily, with a long detailed observation per week. For this, the manager will set up an activity and observe where the child’s interest leads the play. For example, treasure baskets or role play, which are linked to a specific area of learning.

Parent engagement/ home learning

The practitioner feels strongly that she is there to support parents and make them feel valued. Parents are interested in what their child is doing and like to support them at home; as they continue to learn through play she gives them simple tasks to share with their child. The parents enjoy the activities and learning more about their child’s interests.

Improving children’s outcomes in maths: Key to success

- **Identifying where the child needs support; this is easy when you interact with a small number of children all day.**
- **Ensuring children are interested in the activities and tweaking practice if they are not.**

Looking to the future

- **Keeping your own awareness of maths and developments in maths.**
- **And keeping aware of where children have gaps.**

Summary: Early Years (School, Children's Centres and Nurseries)

The following summary provides a brief overview of the particular practices, approaches and actions common across the early years settings which were considered to be instrumental in the development of maths.

Staff training and qualifications

There is a focus across the settings on well trained and knowledgeable staff. In these settings the maths lead or manager was a teacher or held EYTS or EYPS; the majority had done further training or taken a further qualification in maths education. In these settings staff training was in-house by the maths lead or manager. They knew what their staff needed to know and how to develop them. In the teaching school, there was a particularly strong focus on teacher research and staff progressing to Masters Level or beyond; research was integrated into daily practice and contributed to a strong culture of professional learning. In the school, planning, structured around a clear framework, strongly contributed to staff development; in two settings the managers attributed their knowledge to the Maths Champion programme.

Environment

The physical surroundings form an important part of children's maths development. In all settings there was a particular focus on how the surroundings can be adapted to better support and encourage maths. Most had initiated environment changes through an audit. In one of the children's centres, planning included the development of a separate environment plan. In these settings as well as visual displays of number and other related displays at the child's level, equipment and other objects were put in place to stimulate mathematical thinking, for example furniture arranged at certain levels to stimulate thinking around size (high, low, too small, etc). In this setting children have the freedom to move equipment from one area to another, giving them the feeling of ownership. In another setting, carpet tiles imprinted with shapes (circles, triangles, etc) had significantly increased children's awareness of shape and number.

Adult/child interaction

Settings focused on maximising the adult/child interaction to support children in their learning and encourage their independence. Talking with and listening to children was considered an important element of maths development; with a focus on developing mathematical language in some settings. In many of the settings, the maths lead or manager acknowledged the close link between numeracy and literacy and the importance of communicating with children and developing children's communication. Asking the right question at the right time was considered important for development and independence.

Knowing the children well

Across all settings teachers and practitioners know the children well; their strengths, areas for development and interests. This is achieved through effective key working; a key person working with a number of children or through children belonging to key groups. Children are regularly observed/assessed, often on a daily basis, with activities put in place to develop individual children. More detailed observations are carried out weekly.

Clear leadership of maths

This is led by proactive maths leads or managers, who are well qualified with further training in maths

education; they know what they 'don't know', know how to find out and know how to develop staff. They keep up to date through regular network meetings with sharing of good practice, or lead CPD for other settings/schools in the area. They develop maths across the setting, provide effective and focused staff support and development, know how children learn and develop, integrate maths into daily practice and involve parents in their children's maths learning. For many settings, there was a focus on smooth transition to primary school or in the case of the school, to junior school. To this end the maths lead or manager liaised with the schools. The managers of the nurseries visited the schools once the children had started in the autumn term, and the maths lead in the infants school had recommended the use of Numicon to the 'feeder' junior schools, to ensure continuity in children's learning and development.

Making maths fun

Settings acknowledged the importance of making maths enjoyable. This was developed in a number of ways, underpinned by the emphasis on children developing confidence and independence. This was further developed through the environment - entering a maths-rich, stimulating setting and starting the day with a problem to solve, and through games (for example number hunts). In a number of settings Numicon was part of this approach.

Problem solving within a meaningful context

Settings regularly focused on problem solving within real-life situations. In one setting, problem solving sits at the centre of their framework for children's learning and development. In the school, children are engaged through regular themed problem solving activities. In all settings this was supported by the environment with stimulating graphs/pictures on the walls or number games of number lines.

Planning

Planning was carefully thought through in all settings. In some, there was a focus on staff planning together, which also supported their CPD. In the school, a focused framework, based on where the children are in their learning, where they need to get and how they are going to get there, guided all planning. Consideration is also given to the resources, language, EYFS/NC next steps/targets and how the day needs to be arranged for children to achieve. In one of the children's centres, areas of calculation are identified at the planning stage and how they will be addressed with different children is considered. In some settings, learning diaries are used to record children's achievements over the key areas of number, shape, space and measure; this enables staff to reflect on maths development and informs the children's next steps.

Parents

All settings acknowledged the importance of parent engagement in children's learning, but this was an area for further development across many settings. In one setting, the school arranged an annual session for parents, 'how to support your child with maths', and has developed a related area on the website. For children who need extra support in maths, the school invites parents in to explain how to use Numicon and how to work on it with their child at home. In another setting key people had regular informal chats with parents about their child's work. In another setting an online tracking system was used to keep parents informed; this setting had also arranged sessions for fathers and grandfathers to come in and work with their child.

Summary: Childminders

For childminders there is a focus on developing maths through play, maths integrated into daily activities, maths in a 'real-life' context and maths as fun. In one setting children had outings to the shop, having worked out how much items might cost in advance. There is a big focus on talking to children and developing communication. All childminders acknowledged the importance of being part of local networks for their continuing professional development and regularly attended meetings; one childminder had just engaged in a degree programme. Childminders tended to keep up to date with the latest happenings in maths through online websites, such as PACEY and the NDNA.

Conclusion

The strong commitment of maths leaders, managers and practitioners to developing maths across the settings cannot be undervalued. This has included the development of higher aspirations and making maths more accessible not only to children, but to teachers, practitioners, parents and carers and other staff. Looking to the future, the case studies indicate that these particular approaches and practices are here to stay. Primary schools refer to further developing maths across all subjects and areas of the school and developing resilience in children through maths. They also recognise the importance of developing number sense and calculation as firm foundations for further mathematical development, the need for strong reasoning and problem-solving skills in supporting children's independence in learning and further developing or embedding the mastery approach to teaching maths.

For early years settings, the focus for the future relates to the further development of adult and child interactions to better support children's learning and the need to keep a sharp focus on integrating maths into daily activities. Other areas include developing transition, more rigorous monitoring of teaching and learning through data and keeping maths fun.

These case studies show that when primary schools and early years setting have a whole approach to maths, children's outcomes are better and in many cases above expectation. The gap in maths performance at age 11 between children from economically disadvantaged families and their more advantaged peers needs to close in all schools in all areas across England. A strong whole approach to maths in the early years and primary school can change a child's life trajectory.

Recommendations

The case studies have highlighted areas for the development of maths across educational settings in England. These include:

A national maths professional development programme (subject knowledge and pedagogy) for early years settings, which includes better support for practitioners in assessing and supporting children's progress in maths.

Data recording - we propose that the current Ofsted inspection framework is changed so it looks for greater evidence of how well settings are supporting children's early maths development.

Parental engagement, evidence shows the centrality of parent engagement for better outcomes in children's short and long term learning and development. All early years settings and primary schools should have focused approaches to developing this further.

Transition - continuity in approaches to maths support children's understanding and further development. There needs to be a focus on continuity in approach and practice from early years to primary school and primary to secondary school and beyond.

Action research/individual research projects - focused teacher/practitioner CPD builds teacher and practitioner skills and confidence in teaching maths. They become confident in performance and attitude. This is further developed through action research in schools and early years settings or teacher/practitioner individual projects.

Abbreviations

EYFS- Early Years Foundation Stage

EYPS- Early Years Professional Status

EYTS- Early Years Teacher Status

KS1- Key Stage 1

KS2- Key Stage 2

MaST – Mathematics Specialist Teacher Programme

NCB- National Children’s Bureau

NCETM- National Centre for Excellence in the Teaching of Mathematics

NDNA- National Day Nursery Association

PACEY- Professional Association for Childcare and Early Years

QTS- Qualified Teacher Status

REAM- Raising Early Achievement in Maths initiative

SENCO- Special Education Needs Co-ordinator

SLE’s in maths-Specialist Leader of Education in maths

Glossary

Achievement for All - is an independent, not for profit charity founded in 2011 and focused on educational change. Achievement for All works collaboratively through their programmes with schools, early years settings and post 16 settings to improve the education of the lowest achieving 20% using a direct delivery model focusing on aspiration, access and achievement. This has had a very positive [impact](#) on pupil outcomes in maths (and English).

Achievement for All London Primary Programme - The [Achievement for All London primary programme](#) supports 40 primary schools to accelerate the progress of pupils in literacy and numeracy, as well as improving wider outcomes such as attendance and behaviour. Supported by the General London Authority, London Schools Excellence Fund, the project will complete later in 2016. It supports teachers to have a greater awareness of research and good practice to improve the rates of progress in reading, writing and maths for their disadvantaged pupils and those vulnerable to underachievement.

Achieving Early - Achievement for All Early Years programme for nurseries, children’s centres and other Early Years settings. It has its foundations in the Schools Programme and was developed to meet the specific needs of the Early Years sector. [Achieving Early](#) has been tried and tested in settings for two years and has been shown to raise standards and improve outcomes for children vulnerable to underachievement including those identified with special educational needs and those from low-income families.

Bee Bot electronic small toys - small programmable floor robots for young children. They provide a

teaching aid for numeracy as well as literacy.

Catch Up Numeracy - is an intervention which addresses 10 key components of numeracy and enables learners who struggle with numeracy to achieve more than double the progress of typically developing learners. Catch Up Numeracy was developed in 2007, based on the research of Dr Ann Dowker of the University of Oxford.

Central Maths Hub - [Maths Hubs](#) were established by the government in 2014 to support schools and colleges in leading improvement in mathematics education in England; currently there are 35 across all regions of England. They seek to harness all the maths leadership and expertise within an area, to develop and spread excellent practice, for the benefit of all pupils and students. They are part of the wider development of school-led system leadership in England. Each Maths Hub is a partnership, led locally by an outstanding school or college (central maths hub).

City and Guilds functional maths - a practical skills programme in Maths for all learners post 16 (currently under review). Functional Skills provide an individual with essential knowledge, skills and understanding. Development Matters- non- statutory guidance to help early years practitioners implement and develop the EYFS statutory curriculum and assessment/ next steps.

Early Years Foundation Stage Two (EYFS2 / Reception) - the assessment is the EYFS profile.

ECERS 3 Rating Scale - Early Childhood Environment Rating Scale, Third Edition- a scale developed in America by the Environment Rating Scales Institute (ERSI) to enable early years settings to rate the quality of the setting environment. The Scale consists of 35 items organized into 6 subscales:

Every Child a Talker (ECAT) - is designed to help practitioners and parents create a supportive and stimulating environment in which children can enjoy experimenting with and learning language; it helps children to extend their vocabulary so that they are confident and skilled talkers before they start school. It was originally funded by the DCSF in all local authorities on a three year rolling programme between 2008 and 2011.

Every Child Counts maths programmes -Numbers Count; Success@Arithmetic and 1stClass@Number- these interventions run by Every Child Counts, a not-for-profit organisation established in 2008 (with support from the Department for Education) at Edge Hill University have supported over 5,000 schools in and beyond the United Kingdom to help over 125,000 children who have had difficulties with literacy or maths.

Inspire Maths - a whole school primary maths programme, presented in textbooks and based on the Singapore mastery approach

Kinaesthetic learning approach - is for children and young people who learn best through physical or practical activities. Most children learn by doing in the early years of education.

Let's Think Maths - initiated in the 1980s, it has its roots in a catch-up KS3 science intervention. It had an impact on pupils' English and maths and two years later on GCSE results in all core subjects. This resulted in the development of KS3 Let's Think Maths, later extended to KS1 and KS2. The approach is based on

Piagetian and Vygotskian theory in that the lessons operate within the Zones of Proximal Development of a mixed ability class and aim to move children to the next Piagetian level. The approach helps children to develop by focussing on: concrete preparation, cognitive conflict and social construction.

Little Big Maths - a teaching method created by Ben Harding for early years maths. It ensures that there is an emphasis on progression within the context of the child's play, self-discovery and personal learning journey. The framework, known as A-CLIC (Amounts – Counting, Learn Its, It's Nothing New and Calculation) is characterised by accurate steps of progression (known as Progress Drives) that make new learning easy and obvious to children. It is followed by the Big Maths programme.

Mastery approach to teaching maths - an approach to maths followed by many Asian and south east Asian countries, which aims to provide all children with full access to the curriculum enabling them to achieve confidence and competency in mathematics- 'mastery'. Encompassing three core elements- deep understanding (often accompanied by the concrete, pictorial, abstract approach), problem solving and success for all (high expectations), there is a focus on whole class teaching. All children are exposed to rich maths experiences. Schools are generally accessing this through mastery-based curricula, resources or training via the Maths Hubs, or joining the Mathematics Mastery partnership.

Mastery Lead for the Central Hub - teacher/head teacher appointed by partnership of schools to lead the mastery approach to teaching maths (Mastery is one of the areas also addressed by the Mathematics Hubs). Mastery Specialist Teacher- the programme announced in summer 2015 is run by the NCETM in conjunction with Maths Hubs. Primary teachers apply for the programme, which enables them to spread and embed teaching for mastery approaches in their maths lessons.

Maths SSTEW training - sustained shared thinking and emotional well-being, delivered by Denise Kingston (UCL Institute of Education).

Mathematical language - language used to communicate mathematical ideas- e.g. more, less, bigger, smaller etc.

Mathematics Mastery – a professional development programme for teachers which embeds the mastery approach across the school. It is focussed on the three core elements of: deep understanding; problem solving and success for all, with teachers introducing and reinforcing mathematical vocabulary throughout lessons.

Mathletics - an online maths programme for children and young people from the Foundation year through secondary school. It makes maths fun and engaging for children and young people. It is aligned to the curriculum.

Maths - No Problem! -Textbook developed from the Singapore mastery approach.

Maths-Whizz - an online computer personalised tutoring site.

NDNA (National Day Nurseries Association) Maths Champion programme - a 12-month on-line training programme for early years staff, supporting them in embedding maths into play and activities. It is

being evaluated by the Education Endowment Foundation.

National Numeracy - is a charity established in 2012 to help improve practical maths skills and confidence among children and adults and to encourage more positive attitudes to maths. Its main project currently is the [National Numeracy Challenge](#).

National Numeracy parental engagement project - in 2015 this project researched barriers to and successful strategies for parental engagement in their children's maths learning. This included trialling of resources such as NN's [Family Maths Scrapbooks](#). The work developed into a follow-up project with the Mayor's Fund for London which demonstrated improvements in children's attitudes and attainment when parents were actively involved.

Noah's Ark NRICH activity - The NRICH Project is part of the Millennium Mathematics Project (MMP), a collaboration between the faculties of maths and education at the University of Cambridge. NRICH aims to enrich the mathematical experiences of all learners. To support this aim, members of the NRICH team work in a wide range of capacities, including providing professional development for teachers wishing to embed rich mathematical tasks into everyday classroom practice. Noah's Ark is one of the activities they provide.

Number Partners - Lloyd's Community Programme involves business volunteers visiting primary and secondary schools in Tower Hamlets. They spend a lunchtime (either once a week or fortnight) working with individual children to make numbers fun. The one to one interaction with a volunteer from the City gives children an insight into the world of work and business that is in their area of London.

Numicon - a multi-sensory approach to teaching maths. It is designed to help children understand connections between numbers. It can be used at home or school (primary and secondary). Resources along with programmes of study are provided. Many schools use the resources without following the programme of study. They can be used for focused interventions or for whole class teaching.

PD Lead training with NTECM - Professional Development Lead Accreditation is designed for those who lead professional development for teachers of maths.

Philosophy for Children (Philosophy 4 Children) - initiated by Professor Matthew Lipman in 1991 it aims to encourage children to think critically, caringly, creatively and collaboratively. It enables teachers and practitioners to build a community of enquiry.

Pupil Premium - Introduced in April 2011, the Pupil Premium funding is additional funding for publicly funded schools in England to raise the attainment of disadvantaged pupils and close the gap between them and their peers. It is allocated for children who have been eligible for FSM in the last 6 years, children looked after by the state and for those whose parents are in the armed forces.

Rapid Maths - a multi-sensory intervention to help KS2 learners catch up in number skills. Rapid Maths provides a lot of variety including through technology and games, ensuring that pupils in KS 2 have fun when catching up.

STEM project - Science, Technology, Engineering and Mathematics project. The National STEM Learning

Network is the largest provider of STEM education and careers support to schools, colleges and other groups working with young people across the UK. It funds projects for teachers to carry out enquiry-based project work with their students.

Sure Start - a government initiative announced in 1998 to provide services to children under 4 years and their parents and carers. Services include children's centres; all services are situated in disadvantaged areas. Talking and Thinking Floorbooks-Claire Warden's book explores the way that children can be consulted in the early years. It provides information and strategies for practitioners that support adults in listening to children's ideas.

Tapestry - an online system for sharing observations with parents.

Teaching School Alliance - led by a teaching school and include schools that are benefiting from support, as well as strategic partners who lead some aspects of training and development. Strategic partners may include: other schools from any phase or sector; universities; academy chains; local authorities; dioceses or private sector organisations.

Trinity White Rose maths programme - focused on building confidence and resilience in maths teachers and pupils through a mastery approach to teaching maths (developed by the White Rose Maths Hub, led by Trinity Academy Halifax, an outstanding provider based in north Halifax in West Yorkshire).

Zone of Proximal Development - the gap between what a child can achieve without help and what a child can achieve with appropriate support.

References

Department for Education (2015) English indices of deprivation 2015. Available at:
<https://www.gov.uk/government/statistics/english-indices-of-deprivation-2015>.

Department for Education (2016) National Curriculum Assessment KS2, 2015, Revised, London: DfE

Fair Education Alliance (2016) Report Card 2015, London: FEA. Available at:
<http://www.faireducation.org.uk/report-card/>

Hayward, H., Hunt, E., Lord, A., (2014) The economic value of key intermediate qualifications: estimating the returns and lifetime productivity gains to GCSEs, A Levels and Apprenticeships, London: DfE

Jerrim, J. and Shure, N. (2016) Achievement of 15 Year olds in England: PISA 2015 National Report, London: DfE

National Numeracy (2015) Attitudes towards maths; Research and approach overview, Lewes: National Numeracy

National Numeracy (2016) The Parent Factor: A report on the impact of our Count on Us: Parental Engagement Programme, London: Mayors Fund for London

OECD (2016a) Are disadvantaged students given equal opportunities to learn mathematics? PISA in Focus June, Paris: OECD

OECD (2016b) Equations and Inequalities: Making Mathematics Accessible to All, Paris: OECD

PwC (2016) Achieving Schools: Social Impact Assessment, Final Report, Belfast: PwC.

Wheater, R., Durbin, B., McNamara, S. and Classick, R. (2016) Is Mathematics education in England working for everyone? NFER analysis of the PISA performance of disadvantaged pupils, Slough: NFER

Appendix 1

Identifying good practice examples

In identifying examples of good practice in mathematics teaching and learning in early years settings and primary schools across England, it was decided to explore what was happening in educational settings in some of the most deprived neighbourhoods of the country as well as those in more affluent areas that were doing particularly well for their disadvantaged children. At the same time, there was an interest in early years settings and primary schools, which although had not necessarily closed the achievement gap for their disadvantaged children, had successfully ‘turned mathematics around’ and brought all children with them. Aware of geographical differences and socio-economic differences within geographical areas, it was decided that examples needed to consider not only the north, south, east and west of the country, but also schools and settings situated in rural, urban, inner city and coastal areas. Consideration was given to both whole school approaches to mathematics and intervention programmes.

Primary schools in deprived neighbourhoods (DfE, 2015) were initially identified through value-added mathematics scores from national datasets. Further primary schools were identified from those which responded to the FEA website announcement, those highlighted by Alliance members or by national maths education organisations or by other government backed organisations.

For early years settings, in the absence of specific national databases, settings were identified from those highlighted by members of the All Party Parliamentary Group on Early Years Mathematics or those highlighted by Alliance members, in particular PACEY, the National Day Nurseries Association and Achievement for All.

In the final instance, seven primary schools were identified from amongst the 40% most deprived neighbourhoods in England, with three of these situated in one of the 10% most deprived neighbourhoods in the country. One primary school is situated in one of the 50% least deprived neighbourhoods of England, but has successfully closed the gap for its most disadvantaged children. Two are situated in one of the 30% least deprived areas of the country, but have improved the maths outcomes of all children or have started to significantly ‘turn maths around’ across the school.

Of the early years settings, the school, children’s centres and nurseries were all situated in one of the 30% most deprived neighbourhoods of England, with two of them situated in one of the 10% most deprived neighbourhoods of the country. Of the four childminders, two are situated in one of the 30% most deprived neighbourhoods in England, whilst two are situated in one of the 30% or 40% least deprived neighbourhoods of the country. The latter two, both with outstanding Ofsted records, have some children who qualify for 2-year old funding or 3-4- year old funding; they were identified as examples of good practice mathematics amongst childminders.

