

Report on research into maths and science teaching in the Shanghai region

Research by National Leaders of Education and Subject Specialists in Shanghai and Ningbo, China 11-18 January 2013



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Introduction

The National College's **China** Research Programme for National Leaders of Education (NLE), Principals of Teaching Schools and subject specialists was provided to stimulate improvement in the quality of Maths and Science teaching in England by investigating approaches used in those Chinese schools achieving top international PISA rankings in these subjects.

Designed in collaboration with **the National College's Chinese partners**, the Nottingham Ningbo International Leadership Centre and Shanghai Normal University, it built on leadership training for school principals in China by the International Business Unit. Participants were selected because of their potential, as highly successful system leaders, to influence wide networks of schools; their track record in curriculum innovation; and their commitment to adapt and apply their findings in their own and partner schools.

In preparation for the study tour, 23 NLEs, Teaching School Principals and subject specialists from primary and secondary phases, considered themes and developed appropriate research tools with experts from the University of Nottingham.

An intensive, eight day residential research programme took place in January 2013 in the Shanghai and Ningbo regions. Participants visited up to four schools and two universities, receiving high-level briefings on the Shanghai education system and national priorities from the President of Shanghai Normal University, as well as an analysis of the PISA 2009 survey by the Director of the Shanghai PISA Centre.

Participants explored the educational priorities and culture of schools visited. Through classroom observation and discussion with principals, leadership teams, teachers, students and trainee teachers, they learned about teaching methodologies, the curriculum and assessment strategies, gaining insights into those aspects which have proved so successful in securing high attainment levels.

This report reflects the personal observations of participants from their diaries, observation records and interview notes, based on views gained from the highest performing schools in Shanghai and Ningbo. Although some science was seen, the report focuses mainly on maths teaching, reflecting the innovative nature of the work and findings in this subject.

Recommendations are based on reflections prompted by what was observed. Much was striking and inspiring, though it must be remembered that the evidence base was small. There was, for example, no exposure to middle or lower ability students or those in vocational schools. Access to schools, however, reflects a growing trust and new partnerships with the region from which the system leaders benefited.

Implementation projects now being considered in clusters and alliances are outlined. In March, during an Evaluation and Implementation Conference the group discussed findings and shared strategies planned to develop this work. A later report, published by the National College, will describe the impact of implementation over time of ideas trialled and successful practices introduced.

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Executive summary

Based on observations into how Shanghai schools achieve top international PISA rankings in Maths and Science, key recommendations and actions are:

- Attainment levels in Maths and Science for the majority of pupils in each age group in England over time must rise to match those in Shanghai if we are to meet the demands of global competition.

Five to seven year targets are being considered for a high proportion of pupils, especially those of middle and lower ability, to:

- Reach level 5 on leaving primary school, grasping fundamental numerical skills alongside the understanding of mathematical thought and application to problem solving
 - Make four levels of progress to achieve a high grade GCSE by the end of Key Stage 4 or earlier, gaining statistical literacy and financial capability in Maths with more advanced topic options for engineers, future mathematicians and scientists
 - Achieve a good level 2 qualification by the age of 18 that is relevant to their chosen career pathway
- These targets will be achieved through a stronger culture of staff learning, developing specialist subject knowledge and re-focussing roles. In-depth mentoring programmes are to be introduced for newly qualified teachers during their first three to five years, extending the induction period and using the Shanghai model of collaborative planning and regular, shared observations with lesson feedback and evaluation. This will include continued access to mentor and professional support in line with other professions such as medicine or the law. Practice developed in this area should contribute to future national guidelines on teacher induction
 - Specialist graduates should teach Maths and Science in all phases, particularly in primary schools. Teaching Schools will support the development of specialists at a regional level, enabling teachers to continue to gain qualifications, improving subject knowledge and pedagogic skills
 - Teacher research groups, supported by university partners, will be formed within Alliances to match the best of Shanghai and Ningbo practice in developing high quality teachers. These involve joint working and review; observing classes to learn from teachers rather than to make judgements on their effectiveness; and training in action-research methodology. Participants are willing to work with the National College to codify and develop best practice in professional observation and the effectiveness of teacher research
 - Based on Shanghai and Ningbo models, additional teacher non-contact time will be created where feasible, targeting resources to reduce the multiple pressures on teachers. Benefits include enhanced professional development for teachers and time for specialists to provide one-to-one tuition for those pupils falling behind, working with parents to ensure pupils keep pace with their peers
 - The importance, especially in Maths teaching, of repetition and practice should be reflected in the criteria of good/outstanding teaching. Unlike rote learning, this process supports deep learning and is a necessary factor in meaningful pupil progress. Practice and repetition should be deemed features of good teaching and time devoted to them.

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- Improvement in the work ethic in England requires an alignment of education and welfare policies. System leaders would support a national campaign to educate parents in the paramount importance of high-level numeracy, mathematical and scientific skills for their children. Alliances are also developing interactive methods of parental engagement to ensure **on-going support and involvement in their children's education to generate the significant** benefits witnessed in Shanghai and Ningbo.
- **System stability in Shanghai contributes to high standards. The Government's** 10 Year Plan is fixed with a commitment to educational improvement. Participants, through their alliances, networks and teacher associations, will promote the case for national educational planning which goes beyond a single Government term of office, with a commitment to long-term goals and policy stability for schools in England to match those of our South-East Asian competitors.

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Shanghai PISA data

'We rank world best in Maths and Science, not because of the performance of our top students, but because of the small gap between high and low performers. High quality is matched by high equality'.

Professor Zhu Xiaohu, Shanghai PISA Centre



Professor Zhu Xiaohu, Shanghai PISA Centre, briefing delegates

In 2009, following the development of its own curriculum, text books and examinations, the Bureau in Shanghai embarked on the PISA tests for the first time to find out how the quality of education in their region compared with others worldwide.

PISA was a means of policy-making based on data evidence and an opportunity to learn about evaluative approaches likely to improve monitoring. The data is now being used to address underperformance and secure improvement.

The PISA 2009 survey sampled 15 year-old students across the full range of Shanghai schools, including the more challenging vocational schools. Shanghai was the top-performing region in the world in Maths, Science and Reading.

In his presentation to participants, Professor Zhu Xiaohu, Director of the Shanghai PISA Centre, showed the meticulous attention, at government level, to strengths and weaknesses revealed by the test results. Rigorous analysis of PISA data has led to a determination to develop solutions to address any areas of low performance and a commitment to take action.

The PISA data reveals some striking insights: for example, 92% of Shanghai students read for enjoyment every day compared to the OECD average of 62% and the UK figure of 60%. The index of reading enjoyment at 0.57 is much higher even than in other East Asian countries. However, surprisingly for a country which has promoted rote learning, the memorization index at 0.07 is significantly lower than the OECD average and that of the UK.

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Reading scores indicate improvement is needed in access and retrieval skills and in assimilating non-continuous texts- an important life skill. Textbooks and changes in pedagogy are already addressing these weaknesses. Similarly, studies are being carried out to ascertain why girls outperform boys significantly so that teaching materials and pedagogy can be amended.

Whilst teacher-student relations and the disciplinary climate place Shanghai in the first dimension, student attitudes are negative at -0.4, perhaps because of the unremitting pressure schools place on them. The UK, in comparison, is ranked fourth in this category. The evidence suggests that although Chinese students may not enjoy school, they value its importance. There is a drive to boost the happiness of students to increase their personal enjoyment in education.

Most revealing of all, Shanghai tops the PISA rankings for Maths, Science and reading not because of its high performing students but because its lower ability students perform highly also. Indeed, the gap between top and bottom performers in Maths and Science is relatively low. The region scores highly on equity with both high quality and high equality. Shanghai schools with low social intakes are high performing.

In contrast, England whilst scoring well on quality is significantly low in the equality index. Despite being addressed through the pupil premium and improving access to universities, low equity remains as a key issue for the English educational system.

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Chinese culture and expectations

'Diligence redeems lack of ability'

Ofi-quoted Chinese proverb

'Without education: nothing'

Belief repeated by Chinese teachers and students

The Chinese value education as the sole opportunity for self-improvement, status and a position in society. Success in examinations is more highly regarded than any other form of improvement including economic success. Educational ambition is intrinsic to the national psyche.



Dr Yimin Bai, Director of International Exchange Division, Shanghai Normal University briefing participants

Intelligence is no barrier to achievement: hard work rather than ability governs outcomes. While the American Dream is based on wealth creation, the Chinese equivalent is education which determines **each individual's future**. Instead of key stage tests, in China the matriculation focus is the Gaokao at age eighteen to which students devote up to seventy hours of study a week. However, examination pressure and student workload are addressed as concerns in the 10 Year Education Plan.

Parental engagement and investment in education drive the system. Parents accept school policies and decisions, offering support or sponsorship. In return, they expect their children to be given additional tuition by teachers, generally on the same day, attending extra sessions if their progress is inadequate.

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From primary age, parents ensure their children study at home, setting extra work if the school provides insufficient. Private tuition and the use of tutorial schools are the norm, with pressure from relatives and friends placed on any family not making such provision. Estimates suggest that 80% of students receive such support.

Parents actively monitor **their children's** progress through scrutiny of exercise books, teacher text messaging and discussion groups with staff on the Chinese equivalent of Facebook. Happily for teachers, underperformance is regarded a family issue: in a society with a one-child policy, each student may experience pressure in the home from six adults - two parents and four grandparents.

A remarkable work ethic is nurtured in a highly pressurised and competitive environment. Traditional Chinese stories reinforce this, such as a tale of a poverty-stricken family, without electricity or candles, which open a hole in a wall to allow in light from **the neighbour's house so the child may read**. Mantras accompany these stories and proverbs such as: '**Practice becomes habit which eventually becomes beautiful**'. **The intensity of students' concentration in class is partly the result of their cultural heritage.**

Grades rather than social class or catchment areas ensure students gain places in the highest performing schools - a form of meritocracy. In addition, high performing schools are required to take 30% of their students from the poorest areas, with selection is again based on test scores. The Chinese send students from socially deprived backgrounds to the best schools not for the purpose of social engineering but rather to ensure best academic talent, particularly from the migrant classes, is **developed to benefit the country's intellectual and wealth-creating capital.**

Children devise and display their own motivational mottos. A monitoring chart on the wall of a Year 13 classroom identified the Gaokao scores required in each discipline to achieve entrance to each **student's preferred university; all were high ranking and prestigious**. Every student knew exactly the scores they required. Students explained that the idea of not completing homework was simply unimaginable.

A transformation in levels of parental involvement is required to generate the significant benefits witnessed in Shanghai and Ningbo. Improvement in the work ethic in English society would require an alignment of education and welfare policies. Nationally coordinated campaigns, supported by NLEs and Teaching School Alliances, could engage parents in the education of their children and raise awareness of the paramount importance of high-level numeracy, mathematical and scientific skills.

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The role of the teacher

'We wouldn't have time to think!'

Chinese teachers' response to the role of teachers in England

There is a trade-off between class size and teaching contact time. Which system has optimised this?

The Queen Katherine School

Teachers in China spend large amounts of time thinking about how to improve their teaching. Class contact time is dramatically lower, at between 25%-30%, than in English schools where 80%-90% is the norm, although classes are larger with forty or more students. Principals were aware of PISA data showing little correlation internationally between class size and performance.

This high amount of professional non-contact time generates opportunities for extension classes, tutorial work, individual support, detailed planning and systematic and immediate marking with feedback to students. Teacher planning and preparation does not have to be fitted in the evenings and at weekends. Teachers plan so well for all children that no learning is lost. They set and mark work almost every day, sharing marks and test results with eager-to-help parents. Unlike England, schools and their teachers operate in a no blame culture.

Discussion time is built into the day, especially the collaborative planning of lessons. The focus is on ensuring student progression and the development of knowledge through the careful organisation of the topic to be taught. Teachers engage in group planning: their preparation and focus on their two to three teaching groups is extremely intense.

Classrooms in China are open for observation, study and discussion. Teachers are expected to observe each other regularly to develop their skills as practitioners: **'observe each other and better it!'** Non-judgemental observation, in which the observer takes on the role of learner, is widespread.

Teachers are expected to observe others on at least 10 occasions a year. A primary head reported observing 100 lessons each term, both for developmental support and monitoring. After five years, teachers are expected to have observed 360 classes.

The provincial and district bureaus provide strategic direction, releasing school principals to operate as master teachers whose expertise commands staff respect.

Public or demonstration lessons, taught by master teachers, are open to regular small audiences of observers to study and discuss techniques used. Teaching such a lesson is viewed as a high honour. Sometimes parents attend to judge for themselves the quality of the education their children are receiving. In lessons observed by the English participants, there were often at least four other Chinese teachers observing the class as well who would later discuss their observations as a group.

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The Chinese emphasis on professional development at all levels is striking. Teachers are expected to carry out research and develop their skills through membership of one subject research team and an age cohort team, co-ordinated by senior staff. Learning communities, joint planning, regular observation and systems for the formal sharing of practice all support teacher self-improvement.

Teaching Research Groups have been a legal professional requirement in Chinese schools since 1952 when they were set up to enable teachers to study teaching and improve their practice. Teachers regard good teaching as a process rather than an outcome and will jointly plan lessons on a topic which is then taught using the same methodology.

In timetabled research groups they analyse lesson plans, consider lesson delivery and carry out post-lesson reflections, comparing parallel classes. The lesson plan, as well as being a teaching tool, is **evidence of the teacher's professional development**. Refined lesson plans, the pooled collective wisdom of the research group, may be entered for national competitions and success will reflect on all members of the group.

Teachers must produce two research papers each year: the best are honoured with publication. One head of maths explained that although they helped her to develop her knowledge as a young teacher, she now found them a chore. However, these papers form part of the appraisal process and the aim is to support professional development. Unlike in England, appraisal is not linked to student performance.

New teachers are mentored for their first five years in the profession and follow a carefully structured programme of professional development during a 240-hour time commitment. Performance is judged through student attainment data, student feedback and from observations.

Implications for the English system

'Lesson observation is instructive, developmental and embedded in practice- an honour not a threat. And there is no grading system'

Denbigh School

'The real teacher training appears to take place with subject and pedagogical mentors during the first five years of a teacher's career'

The Dean Trust

Teachers are motivated by applying to be assessed for higher-level titles such as: 'master', 'advanced master' or 'famous'.

Belleville School

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- Introduce a three to five-year NQT programme, properly resourced and planned with effective mentoring, extending the induction period and using the Shanghai model of collaborative planning and regular, shared observations with lesson feedback and evaluation. This would include continued access to mentor and professional support in line with other professions such as medicine or the law. Practice developed in this area should contribute to future national guidelines on teacher induction.
- Specialist graduates should teach Maths and Science in all phases. The English system would require a specialist in each primary school, ensuring all teachers in this phase understand National Curriculum level 8 work, the equivalent of GCSE grade B
- Participants from the primary sector are considering the recruitment of specialist staff, a reduction in subjects taught and specialists planning together, discussing pedagogy. Specialist subject teaching will begin in September 2013 in a number of the primary schools represented
- Teaching Schools and Academy Chains could support the development of Maths subject specialists at a regional level, enabling them to continue to gain qualifications, improve subject knowledge and pedagogic skills. These networks could work in partnership with universities and professional organisations such as the National Centre for Excellence in the Teaching of Mathematics and Science Learning Centres, engaging in high quality research and development
- A conversion course to specialize in Maths and Science should be developed for existing primary teachers and delivered by Teaching Schools This could be a day a week for an appropriate period, probably for one to two years. This development would help bridge the gap until more specialist primary specialists are trained and raise standards in primary schools in the short term
- Develop creative ways of giving staff more non-contact time such as larger classes, team teaching and use of higher level teaching assistants, reducing the current multiple pressures on teachers. Specialists could be freed to support students during study periods and in after-school tutorials
- Compulsory membership by all staff of teaching and learning development groups should be given status and time within the school
- Subject-based professional development should be a priority and could be guaranteed by making this a contractual requirement
- Adopt the policy of non-judgemental observations. Participants could work with the National College/Teaching Agency to codify and promote best practice in professional observation
- UK Universities, four of which appear in the top 10 in 2012 QS World University Rankings, would be well placed to support high-level teacher research which impacts on classroom practice. Nottingham University could be invited to support early adopters in the group
- All primary schools could be linked to a local secondary school so that each could provide exemplar teaching in Maths and Science, sharing across the phases. Ofsted could reinforce the importance of continuing professional development in Maths and Science by commenting on this area during inspections

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- Teachers to spend additional non-contact time on one-to-one tuition for those pupils falling behind and work with parents to ensure pupils keep pace with their peers
- Introduce a wider variety of strategies for recognising and celebrating the best teachers. In China, competitions take place at school, regional and national level to reward excellent teachers. In schools display boards celebrate outstanding teachers. Social and community awards confer status.

Expert teachers, such as Specialist Leaders of Education, could provide demonstration lessons and lead research and development groups'

Oldway Teaching School Alliance

'Look at making CPD a formal requirement of continuing professional registration'

Hodgson Academy

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Teaching and learning

In many cases the child became the teacher and children were encouraged to make a comment on their explanation by either extending, contesting or agreeing with that child'

Kibworth Primary

One startling observation was the way teachers constantly asked students not to state their answer but to explain how they obtained it. There is a real focus on method in Chinese teaching'

Sir John Lawes School

Whilst the National College delegation shivered in unheated winter classrooms, often with open windows, students and teachers focussed with complete absorption on the Maths or Science being covered. Like actors on stage, they remained in their learning roles until soothing music to mark the lesson end **freed them to answer visitors' questions.**

Students stay in the same classroom with their own desk and workspace which creates a sense of ownership. Responsibility to learn is theirs. Teachers have two to three classes a week and generally retain the same groups throughout their time at school, developing strong, warm relationships which contribute to the highly positive atmosphere. Classes greet their teachers with a bow and choral salutation.



A range of activities was observed in almost all primary lessons, including class discussion, individual practice, small group discussion and whole class feedback. Teachers constantly asked questions of pupils to check if they were following the lesson. Whilst these techniques are used in England the transitions between activities them was noticeably smoother in Shanghai.

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Every lesson began with teacher instruction, taking up to 30% of the lesson. Students were given chance to consolidate their understanding, often using group work or paired discussion. In Maths this may involve employing different sample calculations for the students to discuss. Time was provided for students to practice their new learning which extended into the daily-set homework. Some teachers were observed asking students to do eye exercises or pressure point massage at the start of lessons to aid focus.

In contrast, at secondary level much of the observed teaching of older students was didactic, though some schools have introduced strict policies limiting the amount of teacher talk to around 25%-30% of the time. In a typical lesson, a period of recap, review and teacher modelling, was followed by a series of questions asked to randomly selected students who stood to respond. The teacher quickly assessed the knowledge of individuals and understanding of the class as a whole.

Lessons were planned to ensure students made progress during the teaching period and over each topic. Clear planning and assessment of homework was used to inform students of progress made and the next steps in learning. Teachers set and marked work by their classes almost every day so they knew how students were coping. **The 'spiral curriculum', observed in textbooks and described by teachers, results in each topic being revisited during the 10 compulsory years of education. Each time a topic is revisited, it is addressed in more depth.**

Classes were not set by ability, though competition for places in high performing schools results in a form of selection. Lessons appeared to be directed towards the high ability. Pupils did not interrupt the lesson with their questions, answering only when asked by the teacher.

When a pupil did not understand or keep up with a fast pace in the lesson, they would arrange for further clarification or even a mini lesson. Without in-class support staff, teachers themselves gave those children not achieving adequately extra tuition either individually or in groups. School policies on this vary: tutorials take place at lunchtime, after school or during time fixed for boosters. About 20% of pupils receive such catch-up tutoring.

At secondary level, it was usual to see teachers directing students to stand up and explain the rationale or answer questions in front of class. Interactive whiteboards were used as projectors to display key questions, prepared in advance, with chalkboards for working on problem solving with students.



In the high schools visited, individual work predominated in classes for high ability students with little peer interaction and a mostly silent working atmosphere with little or no paired or group discussion. Teaching was focused on the understanding of concepts first and then mastery of technique. However, the majority of time was spent mastering technique.

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Lessons observed showed little checking on student progress or differentiation. Opportunities were provided for gifted students to pursue a research project in an area of interest in addition to their normal lessons. In one school the homework was differentiated so that the top five students received a harder piece of work than the rest of the class.

What appeared to be random questioning was targeted at specific students. There was little evidence of plenary sessions to draw out and monitor learning or of Assessment for Learning (AFL) in lessons. Instead teachers relied on summative assessment through homework set every lesson and class tests. Teachers also moved around the class giving feedback and questioning students throughout the lesson when students were working independently. Misconceptions and alternative methodologies were explored through this careful questioning.

Secondary exemplar

PISA data revealed the need for greater creativity and more co-operative, problem-solving styles of learning. Experimental schools are pioneering interactive techniques, frequently based on approaches witnessed by principals on visits to England.

At Ningbo High Tech Zone for Languages, participants witnessed some of the most effective innovative pedagogy in a Year 7 Maths class. Students displayed high-levels of leadership using individual whiteboards to demonstrate problem solving, assessment for learning and some powerfully focussed group discussion.

Organised by tables in groups of four, the students first worked individually, in silence with total absorption. Surprisingly they already had a number of techniques and methodologies for solving problems. After teacher checking that the class understood the concept being explored and the variety of techniques possible to reach the solution, students moved rapidly to the walls where large whiteboards were allocated to each child.

Each wrote up the method they had used to solve a worded problem, using algebraic techniques. Despite their knowledge of formal methods for forming and solving equations, many chose to adopt less traditional diagrammatic approaches, including the use of Venn diagrams and the empty number line.

What followed was exemplary pupil leadership: each child explained their methodology and group members were invited to correct or elaborate the method and accuracy of calculations. Participants observed one group erase an equation five times following some heated discussion.

The teacher then called the whole class around one whiteboard and selected students to explain their methodology. Impressively, all pupils contributed, helped each other and learned from misconceptions. Several participants now plan to introduce this way of working in their own schools.

In a range of lessons, children were seen using talk to enhance their learning and were confident in questioning each other. In many cases, the children took on the role of the teacher.

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Primary school exemplars

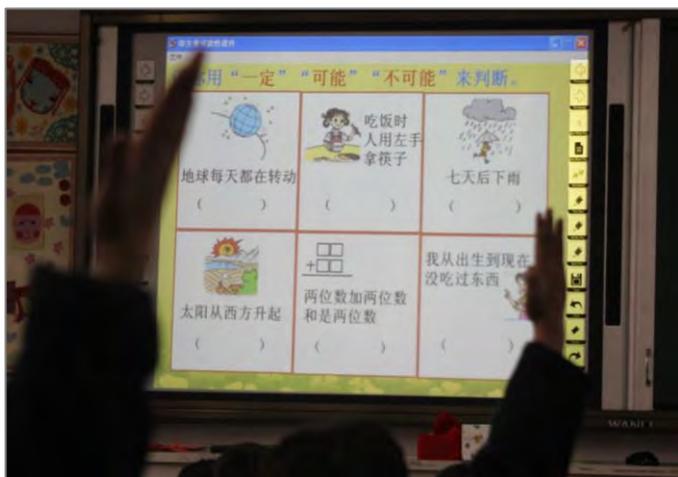
'The emphasis is always on the children that 'can'. Those that 'can't' keep quiet and listen attentively'

Green Lane Primary Academy

'They behave like little teachers'

Participant observation

In primary schools, all children carried out the same activities; there was no task differentiation. Whatever their ability, all children were expected to complete classwork in school or at home. Work was generally marked with a tick or a cross and contained no written feedback. However, incorrect work led to tutoring during lunch or after school.



Students turned to face the front instinctively for whole class discussion, sitting with hands on their knees, raising hands to answer questions.

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Older students reported having been supported by the 'smarter' children in the class. Help from peers and peer assessment were used effectively. It appeared normal practice for the child pictured to stand to help her classmate answer the question.

This practice could be encouraged in England, where primary age children are more likely to seek teacher help.



In a similar primary school example, the question $72 \div 3 =$ was put on the board. The teacher displayed a grouping slide. The children were asked to answer the question in the most efficient way for them. The teacher invited students with different methods to represent this question and asked them to work on large whiteboards for the whole class to see.

The use of such whiteboards ensures visibility of working for other students, clarifying ideas and enabling the children to challenge and debate each **other's reasoning**.

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The teacher invited the class to explain their methods, look at the examples and decide upon the most efficient. A question-and-answer session, led by the children, was impressive. For example, one child asked where a certain number had come from. During this activity, the teacher observed the community of enquiry.

This approach could be used in English schools.

After the pupil-led conversations, the teacher broke the question down in terms of sharing and linked this to more formal written methods. The class was asked to use the most efficient method. The **children's ability to call upon their mental times table and division knowledge** was striking.

Recall was very high across the mixed ability class more advanced than in England.



In a lesson on probability, all students were engaged, demonstrating keen body language. They participated in a whole class game: pulling coloured balls from **the teacher's bag and observing one** colour appear less frequently than the other.

Students then carried out a similar activity, recording their colour on three trials.

Notably, compared to children in England, they moved quickly between activities with no lost time in transitions.

In other lessons observed, participants were struck by the amount of 'over-learning' involved with the same process repeated many times before a problem was changed.

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The pace of the lessons reflected the high expectations ensuring no time is wasted. Transitions between activities were seamless, time spent on each well-judged and students were aware of routines and requirements.

Concepts were developed through the use of manipulatives, alongside informal and formal written methods. Oral rehearsal was practised as a whole class, in pairs and as individuals. Practical resources were used such as stick bundles to support the development of division calculations, reinforcing the understanding behind calculations and written recordings.

Pupils were routinely expected to share their work with the class, articulate their understanding clearly and respond to questions and comments from their peers. This approach seems to lead to deep learning.

Implications for the English system

'The ability to recall times tables was very high across the mixed ability class- more advanced than ours in England'

Barwell Church of England Academy

'Do we race children through demonstration of methods too quickly, before they have become fully comfortable with the method used? Is this part of the no good at Maths culture?'

Portswood and St. Mary's School

- Regular use of peer support and peer-to-peer-assessment
- Introduction of whiteboards to ensure visibility of working for other students, clarifying ideas and enabling the **children to challenge and debate each other's reasoning**
- Focus on method by asking students not to state their answer but to explain how they obtained it
- Develop the role of children as teachers
- Train children in moving rapidly between transitions
- **Develop the use of 'over-learning': repeating the same process many times before a problem is changed**
- Use oral rehearsal for the whole class, in pairs and as individuals
- Use practical resources to support the development of division calculations.

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The curriculum

Compulsory education extends to 15 with three types of secondary school: lower secondary until 15 followed by upper secondary or vocational upper secondary. There is a growing independent sector at around 10% in Shanghai compared to 7% in England.

The new curriculum in China has three components: the basic curriculum for all students delivered through compulsory courses - Maths, Chinese, English, Science and Humanities; the enrichment curriculum provided through option choices customised by each school, including sport, music, art/calligraphy; and the enquiry-based curriculum through extra-curricular opportunities which offers research topics to encourage critical and creative thinking group activities and competitions. Typically, secondary pupils have eight 40 minute lessons, two of which may be self-study, followed by further supervised silent study at school and two to three hours of homework.

Students have a Maths lesson every day; the subject is compulsory until 18. There are similarities in KS2 content but differentiation in English primary schools means that not all children will experience the same topics. In addition, while the primary Maths curriculum in England is cluttered in terms of content, in Shanghai it is carefully structured to enable children to take small steps in developing their conceptual understanding.

There are many opportunities for consolidation to develop procedural fluency. There is a greater emphasis on embedding basic number skills at an early age. Children gain key knowledge and skills by the end of KS1 which enables them to become mathematically proficient in later life.

Although there had been a widely held preconception that China would use rote and standard algorithm methods, there is in fact, an emphasis on understanding and on using a range of models, images and written strategies, alongside developing calculation fluency. Children are encouraged to use manipulatives as well as written work to demonstrate their understanding. Methods of chunking, gridding and partitioning are used to secure understanding, especially of division, and offer flexibility of problem solving. Teachers want to develop student creativity and this is evident in the approach to teaching calculations where methods are varied with no single standard algorithm. Students can be flexible in their thinking, able to use whichever method of calculation they feel is most appropriate.

Pupils eloquently explain their reasoning, rather than relying on remembered routines and algorithms. There is an emphasis on explanation and discussion of understanding. From a young age, students are able to explain their calculation steps clearly to the class using mathematical vocabulary. They are confident in challenging **each other's reasoning and contrasting the relative merits** of different methods of problem solving.

Whilst subject leaders support the use of standard, traditional methods in England, they are convinced of the need for an equal emphasis on developing conceptual understanding in similar ways to ensure children are creative in their approaches to calculations.

On leaving primary school children know multiplication facts and number bonds. Students reported they did not use calculators until senior high school. Junior high school students displayed well-developed algebraic techniques. The mechanics of mathematics, learned in primary school, are applied in secondary school. In contrast, time in English secondary schools has to be spent developing numerical and algebraic techniques; insufficient time is given to applying these skills to real life contexts.

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High Schools visited had a variety of specialism: Experimental Schools, delivering the curriculum in a variety of modes, Number One Schools, the highest achieving academically, Language Schools, and Arts Schools. There is a common core curriculum in Mathematics with no differentiation of teaching **groups apart from students' optional** curriculum choices.

The Chinese Maths curriculum at secondary level is similar to that in England for higher ability secondary students but the complexity of examples and level of difficulty is higher, particularly linking different areas of the curriculum. Participants observed a regular emphasis on the range of different methods and approaches that could be used to solve questions posed, working systematically to discover the most appropriate method to select.

Chinese teachers reported spending up to a month at a time on algebra, securing knowledge and understanding with perhaps only three lessons on probability. The National textbook for both high school students contained much work on algebra and higher-level geometry. The key feature of Maths lessons is their daily regularity and emphasis on practice rather than rote learning. Students practice repeatedly the concepts introduced, ensuring they are strongly embedded. This practice, unlike rote learning, supports deep learning.

Students observed at a junior high school were applying algebraic techniques to solve worded problems which were more sophisticated than in English schools where progress in mathematics is sometimes hampered because the basic mathematical skills and knowledge are not secure. In England, students sometimes have to stop part way through a multi-step problem to work out what should be a basic number fact, breaking their train of thought.

Although the mathematics curriculum in China is narrower than that in England, within this more limited range work is covered to a far higher level. KS4 work observed was significantly more **advanced than that done in participants' own schools. A sixth form equivalent algebra lesson started** at A-level C4 but later covered concepts taught in England to second year undergraduates.

Textbooks, given to students to use both in school and for homework, support this process. Students have these to keep and annotate, enabling deep understanding of each topic. Teachers do not expect students to work through them page by page. They spend a great deal of time planning lessons to support conceptual development and understanding, encouraging students through oral rehearsal and providing opportunities for them to explain their learning to peers. Standard textbooks are used across a whole province.

As in England, past exam questions are used as a tool to develop learning. In classrooms participants observed teachers using questions from Gaokao papers from other Chinese provinces. There are no examination boards - just one Gaokao test for each province.

In Science at primary level the topics' materials, life science, sun and earth are taught and repeated through a progressive interrelated approach and mainly through lecturing.

In one school, the enquiry curriculum resulted in 70 different interests groups being supported to develop **team-working skills through chosen projects. In contrast to England's experiential approach,** practical work in secondary classes appeared limited to teacher demonstration and occasional set experience such as measuring acceleration.

Class size has a direct impact on the practical aspect of science education. Although some schools visited had very large laboratory facilities, Chinese students reported a lack of practical activity in the curriculum. Most students only experience this to a small extent in their enrichment lessons. Chinese students lack opportunities to experience practical science in action. The Gaokao also focuses on non-practical skills.

China maths and science research international programme report



At 15, students choose either an arts or science route. Three of the four subjects for the Gaokao, and University entrance, are compulsory - Maths, Chinese and English. The fourth choice, from the subject pool: Physics, Biology, Chemistry, History, Geography or Politics, determines whether the course is arts or science. Three quarters of all students choose the science route. Other Arts subjects, whilst available, provide no credits towards university entrance. Nine million students in China apply for seven million university places each year.

Implications for the English system

- Expectations of achievement for each age group need to be set higher than at present. Five to seven year targets should be set for a high proportion of pupils, especially those of middle and lower ability, to:
 - Reach level 5 on leaving primary school, grasping fundamental numerical skills alongside the understanding of mathematical thought and application to problem solving
 - Make four levels of progress to achieve a high grade GCSE by the end of Key Stage 4 or earlier, gaining statistical literacy and financial capability in Maths with more advanced topic options for engineers, future mathematicians and scientists
 - Achieve a good level 2 qualification by the age of 18 that is relevant to their chosen career pathway.
- Changes to the weightings within the maths curriculum to focus on arithmetic and algebra
- Reduction in the content of courses so what is being taught is more focused, allowing depth of understanding
- Use of practice and repetition to ensure learning supports creativity
- Emphasis on applied and active learning strategies to improve motivation and meaning through units such as finance understanding, codes and ciphers, sport modeling and route planning
- Intervention programmes for those falling behind

'How do we ensure that the time is given to practice, practice and practice?'

Parbold Douglas Academy

The Physics observed would be called Maths in England. Avoiding overlap of content between subjects is a lesson that could be learned.

Hallam Teaching School

China maths and science research international programme report

Enrichment and personalisation

'The Shanghai Pearl' was the display of personalised learning through team-based activities, organised competitions and student research papers'

The Dean Trust

At Shanghai Experimental School 'fast learning' in 20 minute slots offered multi-media skills and team building which was energising to witness. Students needing to catch up, were given intense support sessions.

Students undertake self-motivated projects in areas of academic interest, allowing for deeper understanding of chosen specialisms. Timetabled periods of self-study - up to three periods a week - allow the development of creativity, replacing didactic teaching. Papers by high school students based on individual daily research, and those by their teachers serving as role models, are published.

Frequently this research takes the form of competitions at local, regional, national and international levels. Students at Shanghai Experimental School, for example, take part in the HiMCM (High School Mathematical Contest in Modeling). Competition organisation requires individuals, strong in different disciplines, to demonstrate in teams the application of their knowledge to a practical problem potentially of global significance. By definition, such activities are restricted to the minority of really high achievers.

In a recent competition, Shanghai Experimental School students had a time-constrained period to research and present a mathematical model to predict whether Elk in North America were likely to become extinct. Variables such as birth rate, population age, disease, environmental influences, and conservation funding had to be factored in, testing students physically and mentally. The research paper had to be written within a 36 hour timeframe.

They had to form teams with varied academic strengths in mathematics, biology, ICT and writing and formatting reports in English. As a group they said their greatest challenge was at the start: to understand what mathematical modelling was and to learn about and manipulate the software that would best help them to produce the report. They had prepared by reading previous papers and developing an understanding of the software required. Again, though highly impressive, only a small number of students were involved.

In another example, a 16 year old student **deconstructed Rubik's Cube and modelled the** mathematical requirements to solve the puzzle. She then used this knowledge to design her own 3D puzzle on a computer, demonstrating an impressive degree of complex knowledge. Subsequent workshops result in the establishment of interest clubs; students enjoy making items they have developed.

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The ICT resources available to the Chinese students for their personalised learning or self-study impressed the group. One school had the foresight to foster competition between different operating platforms, encouraging students to understand the science and concepts behind each and write applications for them. Although the English ICT curriculum is changing, the Chinese realised some years ago that young people need to understand and develop programming and hardware, rather than simply using software.

Participants saw teachers and students learning together in technology bases jointly work on the building of computers, computer networks and even extend their personal interests into significant projects such as the ergonomic redesign of the keyboard to create one with Chinese characters. For some participants, these examples of personalised learning were 'the Shanghai Pearl'.

Further curriculum enrichment comes from visits to factories and summer camps, much as in England. Schools draw on their social resources with parents and alumni lecturing in schools and university partners supporting learning. Parents sponsor trips to universities and other learning opportunities for the pupils.

One primary school, visited by participants, holds an annual Maths festival, enabling children to showcase their talents with family involvement, newsletters and fact packs. Age-related competitions challenge performance using Maths stories and speed calculations. Family-based competitions involve parents performing on stage with their children watched by other families. Everyone joins in and motivation levels are impressively high.

Participants found evidence of Maths specialist routes in schools, such as mechanics for engineers and statistics for biologists or social scientists. The development of specialist Mathematics routes for older students in England could be highly motivational, providing synthesis with other subjects.

Direct links between schools and universities are reflected in universities being named in school titles. Universities provide projects and formal support to schools with two-way student visits, modelled by the University of Shanghai and Shanghai Experimental School. A rolling programme of competitions, visits and assistance is open to many schools. Such partnerships would benefit schools in England.

'Teachers ensure students think about lessons by asking them to prepare with research. They arrive already ahead in their learning'.

Notre Dame High School

'I would like our students to be more articulate in explaining their reasoning and will encourage this debating style'

Lincroft School

China maths and science research international programme report

Government policies

'We don't use data to punish schools!'

*Professor Zhang Minxuan,
President Shanghai Normal University*

The degree of system stability is impressive: strategic planning carried out at provincial, district and school level is used to devise a 10-year plan which is implemented without intermittent change. The **Government's** 10 Year Plan was fixed in 2010, prescribing developments until 2020 with a commitment to educational improvement and increased spending.

The agreed national syllabuses and textbooks, which allow teachers to focus on knowledge, skills and understanding rather than re-planning to meet new examination specifications or Ofsted frameworks, are in striking contrast to the amount of change teachers are accustomed to in England. The English secondary Science curriculum, for example has been revised four times in six years with little time to evaluate impact. In Shanghai the Science and Maths specifications have remained unchanged since 2004.

Long term planning allows teachers to focus on developing the curriculum and pedagogy rather than responding to changing priorities. Effective teaching of mathematical and scientific content, with supporting resources, can be developed in a context of stability. The high national status and priority given to Maths and Science, with a strong awareness of their value for the country, is a feature of this. In addition, while teachers and principals as individuals are clearly and robustly accountable, the teaching profession is highly respected at all levels of society.

Given this informed position, participants, through their alliances, networks and professional associations will promote the case for national educational planning which goes beyond a single Government term of office, with a commitment to long-term goals and policy stability for schools in England to match those of our South-East Asian competitors.

China maths and science research international programme report

Summary of findings and actions planned

Shanghai: participant findings	England: participant recommendations/ plans
<p>Although the mathematics curriculum in China is narrower than that in England, within this more limited range work is covered to a far higher level. KS4 work observed was significantly more advanced than that done in participants' own schools and elements of A level work were at undergraduate level</p>	<p>Expectations of achievement for each age group need to be set higher than at present. Five to seven year targets are being considered for a high proportion of pupils, especially those of middle and lower ability, to:</p> <ul style="list-style-type: none"> • Reach level 5 on leaving primary school, grasping fundamental numerical skills alongside the understanding of mathematical thought and application to problem solving • Make four levels of progress to achieve a high grade GCSE by the end of Key Stage 4 or earlier, gaining statistical literacy and financial capability in Maths with more advanced topic options for engineers, future mathematicians and scientists • Achieve a good level 2 qualification by the age of 18 that is relevant to their chosen career pathway.
<p>Shanghai tops the PISA rankings not because of its high performing students but because its lower ability students perform well. The region scores highly both on quality and equality.</p>	<p>Low equity is starkly revealed as a key issue for the English educational system to be addressed through the strategies outlined in this report. The focus is on raising standards for middle and lower ability students.</p>
<p>Chinese parents value education as the sole opportunity for a position in society, believing hard work rather than ability determining outcomes. Their remarkable levels of engagement are a significant factor in standards achieved.</p>	<p>A national campaign is needed to educate parents in the paramount importance of high-level numeracy, mathematical and scientific skills for their children. Alliances are developing interactive methods of parental engagement to ensure on-going support and involvement in their children's education to generate the significant benefits witnessed in Shanghai and Ningbo.</p>

China maths and science research international programme report

Shanghai: participant findings	England: participant recommendations/ plans
<p>Non-judgemental observations, during which the observer takes on the role of learner, are carried out weekly.</p>	<p>Participants could work with the National College/Teaching Agency to codify and promote best practice in professional observation.</p> <p>Several schools to adopt policy of non-judgemental observations.</p> <p>Expectation that, to progress through the salary scales, teachers will engage in small-scale research projects based on pedagogy.</p> <p>Expectation that skilled colleagues on UPS scale will open their classroom doors to enable colleagues to observe regularly.</p>
<p>Teachers must produce two research papers for possible publication each year through membership of 'Teaching Research Groups', a legal professional requirement in China since 1952. There is competition between teachers and schools for quality leading to publication</p>	<p>Compulsory membership by all staff of teaching and learning development groups considered: require status and time within the school.</p> <p>UK Universities, four of which appear in the top 10 in 2012 QS World University Rankings, would be well placed to support high-level teacher research which impacts on classroom practice.</p> <p>Nottingham University could be invited to support early adopters in the group.</p>
<p>The progression of teachers to leadership posts is dependent on different classifications from levels 1 to 3 and 'master' to 'advanced master' and 'famous' teacher. Progression is dependent on teacher research and examinations.</p> <p>Competitions at school, regional and national level reward excellent teachers and are linked to salary and promotion prospects. School display boards celebrate outstanding teachers. Social and community awards confer status.</p>	<p>Introduce a wider variety of strategies for recognising and celebrating the best teachers.</p> <p>Consideration given to the use of competitions and ways of introducing more local public recognition for teachers.</p>

China maths and science research international programme report

Shanghai: participant findings	England: participant recommendations/ plans
<p>New teachers are mentored for their first five years in the profession</p>	<p>In-depth mentoring programmes are to be introduced for newly qualified teachers during their first three to five years, extending the induction period and using the Shanghai model of collaborative planning and regular, shared observations with lesson feedback and evaluation. This will include continued access to mentor and professional support in line with other professions such as medicine or the law. Practice developed in this area should contribute to future national guidelines on teacher induction.</p>
<p>Chinese teachers are expected to develop their subject expertise as well as their teaching skills.</p>	<p>Subject-based professional development prioritised to complement the focus on pedagogy.</p> <p>This could be a formal requirement of continuing professional registration with pathways from initial training through early years and advanced/expert teacher, co-ordinated by the National College.</p> <p>Ofsted could reinforce the importance of continuing professional development in Maths and Science by commenting on this area during inspections</p>
<p>Specialist subject graduates teach Maths and Science in all phases.</p>	<p>The English system requires primary specialists.</p> <p>Participants from the primary sector are considering the recruitment of specialist staff, a reduction in subjects taught and specialists planning together, discussing pedagogy.</p> <p>Teaching Schools and Academy Chains could support specialist development, both through training and teacher release, working in partnership with universities and professional organisations such as the National Centre for Excellence in the Teaching of Mathematics.</p> <p>A conversion course to specialise in maths should be developed for existing primary teachers.</p>

China maths and science research international programme report

Shanghai: participant findings	England: participant recommendations/ plans
<p>Class contact time at between 25%-30%, around 4 hours a week, is the norm, although classes are larger with 50 or more students. The extraordinary amount of professional non-contact time generates opportunities for collaborative planning of lessons, tutorial work, detailed planning and systematic and immediate marking with feedback to students and parents. Some teachers work up to 12-hour days.</p>	<p>Develop creative ways of giving staff more non-contact time such as larger classes, team teaching and use of higher level teaching assistants to allow significant new practice.</p> <p>Consideration given to the implications for their schools of larger classes and increased professional time. Some participants are researching staff views. Implementation plans indicate experimentation in this area.</p> <p>Teachers to spend additional non-contact time on one-to-one tuition for those pupils falling behind and work with parents to ensure pupils keep pace with their peers.</p>
<p>The key feature of Maths lessons is their daily regularity and the emphasis on practice which, unlike rote learning, supports deep learning.</p>	<p>Practice and repetition should be deemed features of good teaching and time devoted to them. Unlike rote learning, this process supports deep learning and is a necessary factor in meaningful pupil progress.</p> <p>Action on policy and practice is reflected in implementation plans.</p>
<p>The curriculum is carefully structured to enable children to take small steps in developing their conceptual understanding.</p> <p>There is a greater emphasis on embedding basic number skills at an early age. On leaving primary school children know multiplication facts and number bonds.</p> <p>The mechanics of mathematics, learned in primary school, are applied in secondary school.</p>	<p>Reduction in course content would allow greater focus and depth.</p> <p>Time in primary schools should be spent developing numerical and algebraic techniques- currently not taught until secondary school. Curriculum changes to weightings to focus on algebra and arithmetic would support this.</p>

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Shanghai: participant findings	England: participant recommendations/ plans
Sophisticated levels of personalised learning through team-based activities, organised competitions and student research papers impressed observers	Implementation of an interactive, individual whiteboard technique is being planned by several groups.
Participants found evidence of Maths specialist routes in schools, such as mechanics for engineers and statistics for biologists or social scientists.	The development of specialist Mathematics routes for older students in England could be highly motivational, providing synthesis with other subjects
Direct links between schools and universities are reflected in universities being named in school titles. Universities provide projects and formal support to schools with two-way student visits.	Strong, formal partnerships with regular projects, visits and staff links would benefit schools greatly.
The degree of system stability contributes to high standards: the Government's 10 Year Plan is fixed with a commitment to educational improvement and increased spending.	Participants, through their alliances, networks and teacher associations, will promote the case for national educational planning which goes beyond a single Government term of office, with a commitment to long-term goals and policy stability for schools in England to match those of our South-East Asian competitors.

China maths and science research international programme report

Implementation strategies

'We should aim for where the Chinese are going- not where they are now'

Kingsbridge College

The Manor CE Academy

- More dedicated time for the core, especially Maths and English: limit choice to ensure quality at the centre, re-balancing the core. The EBacc has started this process, as did the emphasis on 5A*-C with English and Maths
- Ensure all teachers are specialists, not second subjects
- Priority for timetabling
- Emphasis on homework/additional work in the core
- Special support for those falling behind in English and Maths

Kibworth Primary School

1. Development of specialist teachers within KS2

Immediate Actions:

- Discussions with staff in both schools about strengths and weaknesses
- Teachers in KS2 currently completing a skills audit to identify areas of strength and preference
- Year group teachers to identify which subject they prefer to teach and meet with core subject leaders (Maths and Literacy) to identify a personal development action plan linked to skills and subject knowledge audit for one subject
- Subject leaders to develop and host subject knowledge workshops for subject specialist teaching before next academic year
- Subject specialist teaching to commence in both Parkland and Kibworth KS2 next academic year
- Subject leaders to develop coaching and monitoring plan for the year to investigate the impact of this initiative
- **Host a parents' launch evening to share** changes and findings.
- Organise Governor reviews to check share progress and impact.

Future Actions:

- Develop involvement of teaching school with Schools Direct Maths Specialist Teacher Programme. Course start in September 2014
- Professional discussion with staff about success, impact, workload and future proofing teaching skills.

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2. Reduction of teacher contact time to allow increased CPD and study opportunities

Immediate Actions:

- Head teacher and school business manager to plan for a trial year groups to reduce teacher contact time. Teachers to teach mornings and one afternoon, creating 3 afternoons or 6 hours of non-contact time for CPD and redistribution of directed time
- Recruit extra HLTA cover for specific areas of teaching such as PE, Art, RE, Humanities
- Develop with subject leaders for covered subjects detailed schemes of work which allow HLTAs to cover lessons effectively
- Identify time needed by cover subject leaders to monitor and evaluate subject areas and provide sufficient support for HLTAs to ensure standards remain high.

Future Actions:

- Develop a revised timetable for teaching to ensure that subject teaching is spread throughout the week allowing time to be maximised for other areas of learning and provide time for observations
- Identified teachers to set up lesson study projects/foci and systems to ensure these learning teams are able to maximise their time
- SLT to track progress of children through progress meeting and teacher interviews to review impact of new strategy
- Identify a programme of formal lesson observations to track the improvements in the quality of learning and teaching linked to lesson study projects/foci
- Provide a workshop rationale for parents and involve them in the review of new styles
- Develop use of children as learning detectives to review how they are learning and the impact of specialist teaching
- Build/create video classrooms for broadcasting teaching and for large viewing by teachers.

3. Development of effective intervention support for slow progressing pupils using after school tutoring

Immediate actions:

- Meet with focus teachers to review directed time and potential timetables
- Investigate use of intervention programmes for children particular focus on maths e.g. Numicon and Catch up maths for specialist teachers to use
- Review strategies and potential structure of sessions for teachers to tutor groups of children after school
- Develop a home school agreement and identification process for identified children.

Future Actions:

- Develop workshops and meeting with key parents from target year groups to establish tutoring arrangements and permission strategies
- Develop Monitoring and evaluation strategies with leaders to investigate impact of tutoring
- Develop use of targeted homework to support slower moving students and more able students
- Establish a protocol and system for observing tutoring after school and making resources available to people.

China maths and science research international programme report

Kesgrave

- There is an opportunity to revitalise our approach to the teaching of Mathematics by building in applied, motivational units of study at GCSE. We may also be able to encourage specialism in Maths after GCSE into statistics, mechanics and other pathways to link with student strengths and the other subjects they pursue.
- Extend the reach of our action research. It would be a positive move to extend the NQT mentor phase to three or five years.
- Trial the innovative lesson style witnessed in Ningbo.
- Send a small delegation of Maths teachers to Shanghai to experience their classroom revolution.
- **Adopt a 'fast-learning' enrichment programme across the school. We would use this to heighten motivation and teach everything from Mandarin to Enterprise, Financial Management to Computer Modelling. We have an opportunity to move from outstanding to world-class, by finding and enhancing the 'bright lights' all the Shanghai and Ningbo schools search for in their students and staff.**

George Spencer Academy

- Develop creative ways of giving staff more non-contact time such as larger class sizes, use of higher level teaching assistants, and learning mentors
- Improve the professional development opportunities for staff in first 2 – 3 years of teaching
- Increase number of non-judgmental lesson observations and develop a culture of shared planning and collaborative evaluation of how to improve the quality of teaching and learning
- Further develop action research and invite staff to write research papers
- Introduce a wider variety of strategies for recognising and celebrating the best teachers.

Backwell School and Teaching Alliance

- Re-visit research on developing open, positive mind set amongst students
- Develop focus on on-going CPD for generally successful teachers in their 5-15th years of teaching
- Develop modelling approach by subject leaders to ensure accountability and encourage pride in their own expertise, using SLEs
- Re-visit compulsory membership by all staff of a T & L CPD group: to be given status and time within the school
- Review Reading lessons as part of English curriculum
- Currently reviewing our KS3 skill-based portion of the curriculum- development of these skills, either discretely or within mainstream subjects
- Develop formalised support lessons after-school in English, Maths and Science partnering with neighbouring school to offset cost.

Greet Teaching School Alliance

- **Information to be shared with HTs from the Teaching School Alliance, Birmingham's Primary School Improvement Group, Greet/Conway Federation Governing Body and staff.**
- Tap into national changes- bursaries for primary maths specialists to offer more School Direct places to specialists and to identify local HEIs where they offer this programme.

China maths and science research international programme report

- Plan an action research project across the Alliance to focus on greater mentoring and coaching of NQTs and post-NQTs. This will build on our current CPD programme for NQTs, observing NQTs informally weekly, followed by feedback for focus over the following week. Details to be drawn up **by the Alliance's Strategic Group**
- Consider appointment of Maths specialists (secondary) to work in primary schools across the Alliance. Could require more timetable flexibility as currently Maths in most of our schools is taught in the mornings
- What training (up-skilling) and feedback are we offering to teachers in terms of maths? What can we offer systematically as an Alliance? Can we develop the *master teacher*? Across the Federation offer specific training to teachers who are teaching the most able in each year group. Check that targets are high enough for these pupils
- Do we give pupils enough *hands on* apparatus in KS2? Do we place enough emphasis on number? On repetition and practice? Are our expectations high enough for all pupils? What are we expecting in terms of homework and parental involvement?
- Review Ofsted expectations for outstanding teaching in maths and new National Curriculum. How are we promoting challenge in each lesson?
- Review current maths qualifications of staff across the Alliance to gain a big picture
- Further suggestions from Alliance HTs to be incorporated
- Projected activities and outcomes to be built into improvement planning for each Federation school and the Alliance from September 13 or earlier.

Altrincham Grammar School Teaching School Alliance and Trust

- Primary Maths targets (set at 83% at L4) to be reviewed. In the light of the Shanghai experience, this is too soft a target; we should be far more ambitious for our children
- The Trust to become outstanding in numeracy, literacy and science by setting its own targets well above national targets. The Trust minimum target to be set at L5 in English, Mathematics and Science
- Issues to address:
 - Mathematical knowledge of our primary staff is not at a sufficient level to give our pupils enough challenge and stretch
 - Planning of Maths lessons seems rather limited in a significant number of classes.
 - Slow pace with poor learning outcomes for the children, making it difficult to reach the minimum standard as required nationally. Pupils lagging behind in their knowledge and understanding in Maths continue for the rest of their school life. The Trust cannot allow this to continue.
- Curriculum for these subjects to be revised and planned in such a manner that pupils are able to comfortably achieve a L5 and above by the first term of year 6
- **Revision of teachers' planning time with a subject specialist working alongside them to ensure the literacy, mathematical and scientific knowledge and understanding of the teachers can meet the requirement of a successful lesson**
- There may also be a need for the classroom teacher to specialise and perhaps share classes with other teachers who, in turn, will also specialise. An example could be that, in a three -form entry, each form teacher becomes the subject specialist for that year group in one of the three core subjects of maths, literacy or science. They would then teach all the pupils for that year group.
- More planning time as well as subject specialist support.
- Teachers would also need to upgrade their own mathematical or other knowledge to enable them to become better subject teachers.
- Teachers should be prepared to give one-to-one tuition for those pupils falling behind and work with parents to ensure pupils are keeping pace with their peers.

China maths and science research international programme report

This work will be shared with a view to implement with our Alliance Schools as part of our Teaching School and with many other schools within Greater Manchester and the Challenge Partner schools around the country. We will be working close co-operation with Belleville and Portswood Primary Alliances who were part of the research group to Shanghai. We have already scheduled visits both to Wandsworth and Southampton for March in relation to what was learned in China.

Notre Dame School

- Schools need to involve parents more in the education of their children. We need to get parents to work alongside their children in the evenings, but we have to give them the confidence and understanding of what this means and how to go about it. There should be immediate follow up of problems
- All research shows that students that are literate do better across the board. It is their English level that is the most important. Do students practice skills of English over and over again so they become second nature?
- Curriculum in year 7: is there mileage in lower reading students doing more English and dropping an option? The premise that practice makes perfect so should there be some reading every day? We have to get parents to do 20 minutes each day – what about a systematic book scheme?
- It is not just about reading out loud because this does not mean they have the comprehension skills. Reading should be followed by explaining – no matter what the subject. Do we do this in subjects? If we get parents to come on board, should they also be signing they have done this and put comments?
- Extended writing: are we setting too little? So should we be setting one piece per week – not necessarily in one subject but a cross-curricular piece?
- Should we be giving a reading and comprehension type homework every week because of the change in the exam situation and the fact that, no matter which subject it is, there is more reading to do in the exam?
- Reading lessons: finish with 5 minute description to partner?
- Can teachers do research re best practice in ensuring reading and comprehension gains?
- **Should we give parents a 'script' so they know what is expected of them each evening/week when working with their children...for each year group?**
- Convince parents and students that it is not about talent but about perseverance
- Research shows greater openness of classrooms improves performance: it is not about observation and grading but it is about discussion and improvement for staff. There should be less worry about people in classroom and more working together- bigger discussion of a lesson by the whole department? Or groups within?
- We need to organise joint observations...feedback could be done as discussions and improving practice
- Closer mentoring of staff i.e. having mentors through their whole school life is a positive move
- Down-time in the summer should concentrate on improving teaching and learning – if looking at SOWs, staff working together to create dynamic learning experiences
- If a teacher gains a qualification, the learning must be shared with the rest of the staff. In China all staff have to complete two research papers per year, which all staff then see – could be classroom practice, pedagogy, subject knowledge: constant learning rather than never doing any once qualified
- All students have to join a club or create one. Research labs in Maths/Science could be part of the volunteering programme? Develop skills of lower school? Support at KS 4 science?
- Create papers from students to students, which are published/celebrated
- Use of external competitions on an international basis: getting groups to work under time limits and research together and then put a paper together.

China maths and science research international programme report

- Homework: could we use technology to **link students' research together**
- Idea of fast learning: one area that we could specify is that every child needs to spend an hour each evening going through notes/lessons of the day ...reflective journal on learning?

Bartley Green School and Teaching Alliance

- The appointment of a mentor for each newly qualified teacher for at least the first five years of teaching. The mentors need to have proven ability to deliver high quality lessons themselves.
- The expectation that the mentor will observe and feedback frequently at least in the first two years and that these observations are seen as CPD, coaching, reflective sessions and are not part of the formal performance management/appraisal system. This will remove fear factors and promote the idea of teachers developing their own professional practice
- The expectation that teachers themselves will use some of their non-contact time each year to observe skilled colleagues across the school.
- The expectation that to progress through the salary scales, teachers will engage in small-scale research projects based on pedagogy.
- The expectation that skilled colleagues on UPS scale will open their classroom doors to enable colleagues to observe regularly, especially for Heads of Department or those holding a responsibility point
- Sets 1-3 will be targeted at the highest level to achieve at least grade A
- Set 4: grade B
- Sets 5-7: grade C
- KS1: reception to year 3 teachers to be given specialist subject knowledge INSET up to grade C GCSE
- KS2 - year 4/5/6 teachers to be given specialist subject knowledge INSET up to grade A at GCSE
- KS3/4 – teachers expected to be able to teach up to grade A at A level
- Whilst we will be able to offer specialist subject training to KS1 and KS2 teachers, we will need to seek external consultant to deliver training to our secondary teachers. We need to emphasise that although we may not teach to this level in 11-16 we must nevertheless ensure our subject knowledge remains consistently at the highest level required
- Sharing of the above, instigating change across the 10 schools and primary feeder schools
- Entering national and international competitions
- Awareness of appreciation of Mathematics outside of BGS
- Pupils, parents, teachers to understand the value of Mathematics
- Achievement in Mathematics is an expectation
- Multiplication tables learnt by rote first and the application later. Learnt as $1 \times 2 = 2$, $2 \times 2 = 4$. . . and not 2, 4, 6 in order that link between multiplication and division can be seen and recalled
- **Keep practising so that 'something difficult becomes easier, become habit, becomes beautiful'**
- Teachers to adopt independent work/paired discussion/group work/teacher feedback/independent work . . . (as a cycle for effective learning in the classroom)
- Maths area to be transformed – smaller desks to allow for easier movement around the classroom, mounted whiteboards to provide pupils with their own space to write their answers for paired/group/whole class discussion.

China maths and science research international programme report

Warren Road Teaching School Alliance

Objective	Action	Timescale	Who	Funding	Success Criteria	Monitoring and Evaluation
Further raise expectation among parents and the community to the importance of maths as a subject	– Numeracy parents' evening to raise awareness and broadsheet publication	Spring Term 2013	Headteacher	£500 SBS	Parents and Community able to enthuse about the importance of maths	Governors to evaluate via discussion with parents and the community
Make maths lessons more fun by reviewing the content of lessons and the resources used.	– Review of Maths lesson observations to give feedback on improving the content and resources in lessons	To be completed by 31 st March 2013	Maths Subject Leader	Release time	Pupils able to express their increasing enjoyment of maths	Evidence from pupil conversations
Embed times tables at an earlier age to facilitate future learning	– Revise maths curriculum to facilitate this	May 2013	Maths Subject Leader	Release time	Year 1 pupils confident in 1,2,3,4,5, and 10 times tables	Monitored by HT via times tables success board
Formal methods, especially for calculation are taught from the start	– Revise maths curriculum to introduce formal methods for calculation earlier	May 2013	Maths Subject Leader	Staff training time	Evidence in pupils' books of formal methods for recording increasing to 50%	Leadership Team to monitor and evaluate impact of change July 2013
To keep to the formal method for 50% of the time and in experimental lessons develop strategies to encourage pupils to consider a range of methods for problem	– Model how pupils can consider a range of methods for problem solving	March 2013	As above	Subject Leader Maths release time	Evidence from lesson observations to show pupils using a range of methods and sharing their knowledge well.	LOFs analysed across year groups to note formal methods and problem solving strategies.
	– Provide staff training on the above to ensure	March 2013	As above	Start Feb 2013		

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<p>solving and to articulate the strengths and weaknesses of each one.</p> <p>Practice, Practice, Practice – the Chinese believe that the understanding of number will come during or after the rote learning.</p>	<p>teachers are confident in the use of this method</p> <ul style="list-style-type: none"> – Monitor maths lessons to record the number of time formal lessons and practice are used. 	<p>April – May 2013</p>	<p>As above</p>	<p>Review Sept 2013</p>	<p>Positive feedback from staff training sessions on maths methods and teaching strategies</p> <p>Increase in practice tasks for homework to embed maths knowledge and understanding</p>	<p>Governor responsible for Maths to talk to staff and gain feedback on effectiveness of training</p> <p>Monitored by Year Leaders with results feedback to SMT for evaluation</p>
<p>Increase the rote learning of times tables at an earlier age</p>	<ul style="list-style-type: none"> – Increase the amount of curriculum time spent on rote learning of times tables in Year 1 and 2. 	<p>March 2013</p>	<p>Year Leaders</p>	<p>Nil</p>	<p>Tables time evident on timetables</p>	<p>Monitored by DHTs</p>
<p>Increase the amount of pupil conversations in class to embed understanding</p>	<ul style="list-style-type: none"> – Encourage pupil conversations and add to LO form 	<p>March 2013</p>	<p>Leadership Team</p>	<p>Nil</p>	<p>Pupil conversations evident in planning</p>	<p>Evaluated by Governors on Review Day</p>
<p>Invite pupils to demonstrate alternative methods on the whiteboard in front of their class mates so that the method can be a focus for discussion</p>	<ul style="list-style-type: none"> – Model lessons to show teachers how to deliver this effectively linked to staff training 	<p>April 2013 – June 2013</p>	<p>Maths Subject Leader</p>	<p>£1,200 release and cover costs SBS</p>	<p>Pupils confident in explaining their methods to others</p>	<p>Feedback from model lessons positive and changing existing practice</p>

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Revise our maths syllabus to include the teaching of mathematical concepts at an earlier age	<ul style="list-style-type: none"> Maths Subject Leader to discuss with SMT colleagues the changes to the curriculum 	May 2013	SMT	Staff Meeting Time	Mathematical concepts clearly being planned at an earlier stage	port to Governors June 2013
Focus pupils attention to the need to increase the speed of their calculations	<ul style="list-style-type: none"> Assembly times to focus on speeding up calculations 	April 2013	HT & DHTs	Assembly times	Pupils demonstrating increasing speed in oral, mental and written form.	Records show improvement in speed of pupils' calculations
Continue with AFL in its current form	<ul style="list-style-type: none"> Continue to develop AFL, ensuring new members of staff are familiar with the process. 	On-going	DHT KS2	Staff meeting time	Staff confident in the use of AFL to drive learning forward	Monitored by SMT
Continue to provide termly progress updates to parents	<ul style="list-style-type: none"> Termly broadsheets to parents & community published 	31 st March 2013	HT	£500 publication costs SBS	Parents aware of the school's additional focus on maths and supportive of its' aims.	Parent Governors to canvas parents for feedback on progress to date
Review the content of the maths curriculum to ensure the content and teaching styles planned appeal to boys	<ul style="list-style-type: none"> Double check content, resources and methods appeal to boys as well as girls 	April 2013	Subject Leader for Maths	Release time for Maths SL	Curriculum planning shows adjustments to resources and methods used	Evaluated by the Leadership Team and reported to Governors June 2013
Continue to provide extension teaching for the all pupils, including the most able mathematicians	<ul style="list-style-type: none"> Observe extension maths sessions and consider whether they meet current need 	April - June 2013	Leadership Team	£400 resources SBS	Most able mathematicians challenged and entered for UK Maths Challenge	Evaluated by HT, following monitoring feedback from Leadership Team, and reported to

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						Governors June 2013
Continue to work on our transition policy to ensure pupils move easily between all key stages	<ul style="list-style-type: none"> Work with partner secondary schools to ensure pupils have the appropriate skills and knowledge to move to KS3 easily 	May – June 2013	Year 6 teachers	Release time for Year 6 teachers	Positive feedback in Sept 2013 from partner secondary schools	Evaluated by Family Worker through liaison feedback Sept 2013
To share outcomes from our experiences with other schools within Warren Teaching School Alliance	<ul style="list-style-type: none"> Share China Report and Action Plan with Strategic Partners Publish termly broadsheet across WTSA Share resources and strategies with interested partner schools 	14.3.13 31.3.13 19.7.13 1.9.13	Leadership Team Headteacher Maths Subject Leader	Meeting Time £100 Broadsheet costs from WTSA Research budget	Engagement by 10 WTSA schools Positive feedback from 10 schools on how outcomes are raising standards	Evaluated by Leadership Team via survey results undertaken Sept 2013 and March 2014
<p>Longer Term Objectives</p> <p>To provide a 5 year support structure for NQTs and first year teachers – linked to WTSA training programme</p> <p>To increase CPD support for teachers with two to five years' experience</p>	<ul style="list-style-type: none"> To agree a 5 year plan To ensure finance stream for plan To implement first year of plan To embed peer observation Further parents briefing and tutorials in Autumn Term and Spring Term 2013/2014 	Start Sept 2013 On-going Autumn Term 2013 Spring Term 2014	Leadership Team INSET Leader Maths Subject Leader	Meeting time £10,000 CPD budget Staff time	Steady improvement in the percentage of lessons judged good and outstanding from Sept 2013 to July 2018 Positive feedback from teachers on CPD support	Monitored by WTSA Strategic Partners and evaluated by report to Governors. Monitored by Leadership Team and evaluated by analysis of survey feedback.

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<p>To further raise parental and teacher expectations in maths</p> <p>To create a pupil research group to investigate their own learning successes</p>	<ul style="list-style-type: none"> Set up a School Council Research group 	<p>September 2013</p>	<p>Leadership Team</p>	<p>As above</p>	<p>Pupils engaged purposefully in research</p>	<p>Feedback from pupils and parents gathered to inform Strategic Partners.</p>
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Lincroft School

Area to Develop	Actions	Timescale	Staff Involved
<p>CPD Network</p>	<ul style="list-style-type: none"> Arrange further opportunities for Federation maths department staff to meet for teaching and learning CPD sessions (currently held termly) Be creative to design opportunities in curriculum time for department staff to get together to develop ideas Share findings at (NBST) maths Working Party Meeting (19 schools) look to develop CPD opportunities for schools by joint collaboration Share findings at Bedford Borough maths Subject Leader Development Meetings (10 schools) Pilgrim Learning Trust CPD Days for maths staff 	<ul style="list-style-type: none"> Dates for 2013-14 meetings in diary during the Summer Term 2013 Discuss opportunities with SLT in Summer Term 2013 Meeting date 26/03/2013 Meeting dates 27/02/13 and 24/04/13 TBA Summer Term 2013 	<ul style="list-style-type: none"> LP, AST, HODs, All federation staff SLT, LP, HOD LP, NBST School HODs LP, Bedford Borough HODs LP, PLT Staff
<p>Focus on Calculation Strategies</p>	<ul style="list-style-type: none"> Develop currently trialled Calculation Scheme for whole school implementation Introduce a 10 minute calculation practice section to each maths lesson, including a literacy element with problem 	<ul style="list-style-type: none"> Work on development of scheme to take place in Summer Term 2013 Lessons trialled with 3 classes Summer Term 2013, findings shared with 	<ul style="list-style-type: none"> LP, AST, HOD LP, AST, HOD, maths

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	solving on a particular day	department CPD day Autumn term 2013 and implemented in full	department staff
Over-Learning Homework	<ul style="list-style-type: none"> - Develop Resource Bank of 'Over-Learning' Homework Sheets - Promote scheme with parents, pupils and staff. Monitor use by teachers once implemented - Support on-line (you-tube examples, edmodo discussion boards) 	<ul style="list-style-type: none"> - Work on further developing homework scheme Spring/Summer 2013 - Implemented Autumn 2013 - Continue development of online support videos to be added to current resources channel. Work shared with all staff summer term 2013. 	<ul style="list-style-type: none"> - LP, AST - LP, AST, HOD, maths department staff - LP, AST, HOD
Times Tables	<ul style="list-style-type: none"> - Discuss Times Table practice and routines with (NBST) Maths Working Party - Develop a scheme for routine times table practice 	<ul style="list-style-type: none"> - Discussions at meeting 26/03/2013 - Development and trial in Summer term for full implementation Autumn 2013 	<ul style="list-style-type: none"> - LP, NBST maths HODs - LP, AST, HOD, maths department staff
Practical Resources	<ul style="list-style-type: none"> - Develop resource of place value counters - Trial with classes, record on video examples of practice to share - Run CPD session for staff sharing the resources and concepts developed - Develop lessons with teachers and plan for trial into 	<ul style="list-style-type: none"> - Counters purchased and labelled Feb 2013 - Counters trialled with 3 classes Feb 2013, videos recorded of use - CPD meeting held to share resource bank of ideas with maths staff (School 25/02/2013, Bedford Borough 27/02/2013, NBST 26/03/2013, Federation 20/05/2013) - At meetings and in subsequent weeks 	<ul style="list-style-type: none"> - LP - LP, AST, HOD - LP, AST, HOD, staff from NBST, Federation, and Borough - Same as

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	<p>scheme of work</p> <ul style="list-style-type: none"> Teachers to use practical resources more in lessons and pupils to have free access to manipulative resources to support calculation Meeting to discuss lessons and add to resource bank of ideas Present resource and ideas at the NCETM East of England CPD network Meeting 	<ul style="list-style-type: none"> Subsequent weeks to meetings Meetings held (School 11/03/2013, Bedford Borough 24/04/2013, NBST TBA, Federation TBA) TBA Summer term 2013 	<p>previous</p> <ul style="list-style-type: none"> Same as previous Same as previous LP, AST
Scheme-Resourcing and Lesson Planning	<ul style="list-style-type: none"> Reorganise timetable for Year 5 Summer term scheme of work Provide template for resources to be added to scheme of work Meeting for the initial planning of lessons and development of ideas First unit to be taught and resources/ideas recorded on template Units of work rotated and added to 	<ul style="list-style-type: none"> Timetable reorganised Spring Term 2013 Template developed to be shared at Summer CPD day Meeting held at beginning of Summer term 2013 First unit taught 15/04/2013 to 26/04/2013 Units rotated fortnightly during the Summer term 	<ul style="list-style-type: none"> LP LP LP, maths department staff Maths department staff Maths department staff
Technology	<ul style="list-style-type: none"> Online support network for teachers Online support for students 	<ul style="list-style-type: none"> Online network created for teachers and shared with department staff at Summer CPD meeting Edmodo platform shared with staff across school to implement with 	<ul style="list-style-type: none"> LP, maths department staff LP, school staff

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	<ul style="list-style-type: none"> - Develop help videos to share via SAF YouTube channel 	<p>students</p> <ul style="list-style-type: none"> - Videos developed continuously 	<ul style="list-style-type: none"> - LP, AST, HOD
Classroom Arrangement	<ul style="list-style-type: none"> - Consider arrangement of desks in classrooms and allowing for whiteboards so pupils can visibly be seen solving problems by others 	<ul style="list-style-type: none"> - Discussion with SLT and site manager about funding for classroom rearrangement 	<ul style="list-style-type: none"> - LP, SLT, site manager
Student Discussion	<ul style="list-style-type: none"> - Develop students as teachers – to encourage discussion and questioning of understanding - Model lessons where pupils are encouraged to teach and question each other - Share video of example lessons 	<ul style="list-style-type: none"> - AST and LP to work on developing confidence within classes Spring Term 2013 - Lessons by AST and LP, observed and filmed in Summer Term - Shared at Federation meeting 20/05/2013 	<ul style="list-style-type: none"> - LP, AST - LP, AST, department staff - LP, AST, Federation staff
Parental Involvement	<ul style="list-style-type: none"> - Offer a maths evening for Year 5 parents & pupils early in September to share developments and offer support - Offer drop-in sessions each month for parents to attend and ask questions about maths to support pupils 	<ul style="list-style-type: none"> - Meeting put in calendar Summer term 2013 to happen in first two weeks of Autumn term 2013 - Drop-in sessions trialled in the Summer term 2013 to put in place Autumn term 2013 	<ul style="list-style-type: none"> - LP, AST, HOD, department staff - LP, AST, HOD, department staff on rota

LP = Lead Professional for Maths (Federation Schools)

AST = Advanced Skills Teacher

HOD = Head of Department Lincroft School

NBST = Schools previously in the North Bedfordshire Schools Trust

Federation = Sharnbrook Academy Federation Middle Schools

PLT = Pilgrim Learning Trust

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Participating Schools/Teaching School Alliances

The following National Support Schools and Teaching School Alliances participated in this research and their contribution is reflected in this Report:

Altrincham Girls' Grammar School Teaching School Alliance and Trust, Manchester

Backwell Teaching School and North Somerset Alliance, Bristol

Barwell Primary Academy, Hinckley

Belleville Teaching School, Wandsworth

Bartley Green Teaching School, Birmingham

Denbigh Teaching School and Shenley Brook End School, Milton Keynes

George Spencer Academy and Teaching School/Ashfield School, Nottingham

Green Lane Primary Academy and Teaching School, Leeds

Hodgson Academy and Teaching School, Blackpool

Kesgrave Teaching School Alliance, Ipswich

Kibworth Primary School, Kibworth, Leicestershire

Kingsbridge Academy and Teaching School Alliance, Kingsbridge, Devon

Lincroft School, Bedford

Manor Academy and Teaching School Alliance, York

Notre Dame Teaching School Alliance, Sheffield

Oldway Teaching School Alliance, Paignton

Portswood Teaching School Alliance, Southampton

Parbold Douglas Academy, Wigan

Sir John Lawes Teaching School Alliance, Harpenden, Hertfordshire

The Dean Trust, Ashton on Mersey

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The Queen Katherine School, Kendal

Warren Teaching School Alliance, Bromley

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Shanghai Experimental School	
Foreign Language School attached to Shanghai Normal University	
High School attached to Shanghai Normal University	
Number One Primary School attached to Shanghai Normal University	
Shanghai Normal University Demonstration Primary School	
Ningbo Foreign Language School	
Ningbo High School	
Ningbo National Hi-tech Zone Foreign Language School	
Ningbo Wanli International Senior High School	
Ningbo National Hi-tech Zone Experimental School	

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