

Supporting children to be active and influential participants in mathematics lessons through effective use of assigning competence and pre-teaching

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Report of an action research project

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Summary of findings

This project explored how vulnerable children could be supported to be active and influential participants in maths lessons, accessing age-appropriate mathematics, through the use of pre-teaching in advance of maths lessons and assigning competence within maths lessons.

The impact has been extraordinary. We have had the privilege of witnessing teachers change children's lives through this project. Children who had no belief in themselves as learners in mathematics now believe in themselves, and are actively involved in their own learning and in the learning of others – Maths Adviser

Both teachers and children involved in this project report that the combination of the two strategies (pre-teaching and assigning competence) had a positive impact on levels of participation and the ability to be influential in lessons. For many of the children it not only allowed them to access age-appropriate mathematics, it also had a positive impact on their attainment in tests (see Appendix 5)

This combination of the two strategies led to the following findings, starting with the most important finding:

1. **Pre-teaching must be run by the class teacher** - if the pre-teaching is going to benefit the children in the maths lesson it must be run by the class teacher. The children value the time because it is with their class teacher. Because the children and class teacher have a shared experience it gives them a shared understanding and common references which they take into the whole class lesson.
2. **Pre-teaching and assigning competence maximise learning in lessons** - by having class teachers provide the 'additional time' and putting it *before* the learning happens in a maths lesson, rather than *after* it, children are provided with even more additional time and opportunities for learning than just in the pre-teach. This is because it makes the lesson a meaningful experience for the children, rather than them experiencing it as a time when they don't understand and feel they have failed, and teachers are better placed to support their learning in the lesson.
3. **Pre-teaching and assigning competence have a positive impact on children's confidence in themselves as mathematical thinkers.** This was demonstrated by:
 - a. **Engagement from the start of the lesson** – both the focus children and the teacher benefit from pre-teaching in terms of their focus and engagement with the mathematics at the start of the lesson.
 - b. **Offering contributions and being ready to respond** – the children offered contributions more frequently, which demonstrated a shift in attitude and resulted in positive feedback which then led to further participation and the teachers were alert, looking for the children to contribute.
 - c. **Asking different questions and seeking out a challenge** - the children were able to think more mathematically in the lessons because they were less anxious and therefore paying less attention to their emotional wellbeing. This resulted in the children being prepared to ask questions that focused on the mathematics, rather than emotional reassurance, and to want to tackle challenging mathematics.

- d. **Accessing resources independently** - this included children using: their pre-teach journal as an aide memoire; working walls; and maths equipment.
 - e. **Explaining thinking** – the pre-teaching meant the children were better able to explain their thinking; this in turn meant they had the opportunity to deepen their understanding, in the lessons, when asked to explain.
 - f. **Supporting others** – this included using resources, drawing and explaining
 - g. **Active participation in conversations** – the children became willing to challenge others, including high-status children, and defend their own thinking.
 - h. **Changes in behaviour and attitude outside of the classroom** – parents reported positive changes in terms of children’s interest in and attitude towards their learning reflected in an increased willingness to talk about their learning at home.
4. **Pre-teaching can have different structures and focus on different things.** Key to pre-teaching sessions being successful, along with them being taught by the class teacher, are the following:
- a. **Pre-teaching must provide children with access to the mathematics in the maths lesson**, allowing them to actively participate. It is **not** about being able to replicate in the lesson the maths from the pre-teach session **nor** is it about teaching the whole lesson in the pre-teach session. It is about preparing the children to be able to engage in the struggle of the mathematics in the lesson by removing additional barriers.
 - b. **Identify one thing that will allow the children to access the mathematics in the lesson.** This could include:
 - i. Introducing new mathematics, new contexts and new contextual resources
 - ii. Rehearsing prior learning
 - iii. Rehearsing language
 - iv. Allowing confusion to happen
 - v. Using misconceptions
 - vi. Using images/resources (especially for the first time)
 - c. **Timing** - most teachers found that having the pre-teach on the same day as the maths lesson worked best although some did run sessions at the end of the day in advance of the lesson the next day. Some teachers liked to run the session immediately before the lesson whilst others liked a gap as it allowed them time to reflect on how they might want to adjust the lesson in light of the pre-teach session.
 - d. **Frequency** - teachers varied in terms of how frequently they ran pre-teach sessions but at least weekly seemed to work best. For vulnerable children there is a need to provide regular sessions at least in the early part of the year. These children benefited from being involved for the whole year; flexibility may be important in terms of making pre-teaching work in the long term with the option to vary at least some of the children who are involved, but the impact on the focus children in this project relied on their sustained involvement in the pre-teach sessions for the full year.

- e. **Length** – there is no set length for a pre-teach session, the important thing is clarity about the purpose of the session and taking the time needed. Fifteen minute sessions were often needed, for example when the focus was on introducing a new bit of mathematics, but sometimes a few minutes immediately before a lesson prepared the children for participation, for example through rehearsing language.
5. **Assigning competence is a powerful tool but can be more challenging for teachers to use effectively.** The following were found to be important when considering assigning competence:
- a. Be subtle – it is not about a performance or memory test
 - b. Comment on the thinking/idea not the child
 - c. Use simple phrases to draw attention to valuable thinking
 - d. Anticipate and monitor
 - e. Support other children to publicly state how they have been helped by a class member
 - f. Subvert hierarchies that exist in the classroom
 - g. Attend to classroom culture and school culture.

Professional Development for Teachers

In addition to the findings above, the year-long project allowed teachers to engage in a sustained piece of professional development which had a direct impact on them in their work.

The two elements of the project identified by the teachers as being most influential on their own practice, were the collaborative lesson research cycles and the support of a 'knowledgeable other' (maths adviser). It is important that any professional development is planned into the school day, so that it is valued both by participating teachers and by their senior leadership team.

Introduction

Currently, in most English schools and classrooms, there are children who are struggling to access mathematics appropriate for their year group and teachers have to make decisions about how best to support these children every day.

The National Curriculum states that: '*The expectation is that the majority of pupils will move through the programmes of study at broadly the same pace*' (DfE 2013 Page 99). This, coupled with the teaching for mastery agenda as set out by the National Centre for the Excellence in Teaching Mathematics (NCETM) provided the education context for this project.

One of the key aims of teaching for mastery is to ensure that all children have:

“...a **deep** understanding of the mathematics they are learning so that:

- future mathematical learning is built on solid foundations which do not need to be re-taught;
- there is no need for separate catch-up programmes due to some children falling behind;
- children who, under other teaching approaches, can often fall a long way behind, are better able to keep up with their peers, so that gaps in attainment are narrowed whilst the attainment of all is raised.”

Teaching for Mastery: Questions, tasks and activities to support assessment Askew et al 2015

As children come into school with vastly different experiences, one of the challenges is how to provide each child with the necessary experiences for them to understand deeply. In 'Learning for Mastery', written in the 1960s, Bloom identifies that: "*Our basic task in education is to find strategies which will take individual differences into consideration but which will do so in such a way as to promote the fullest development of the individual.*" He goes on to say:

“...Carroll's (1963) view that *aptitude is the amount of time required by the learner to attain mastery of a learning task*. Implicit in this formulation is the assumption that, given time, enough, all students can conceivably attain mastery of a learning task. If Carroll is right, then learning mastery is theoretically available to all, if we can find the means for helping each student. It is this writer's belief that this formulation of Carroll's has the most fundamental implications for education.”

Learning for Mastery Bloom 1968

The phrase '**given time, enough**' contains a challenge; the challenge of providing additional time for children who need it in a form that will maximise impact whilst minimising disruption to the rest of their learning. This is discussed within NCETM literature related to teaching for mastery in mathematics in England, where the practice in Shanghai has proved influential and 'rapid intervention' is suggested.

Pupils' difficulties and misconceptions are identified through immediate formative assessment and addressed with rapid intervention – commonly through individual or small group support later the

same day: there are very few 'closing the gap' strategies, because there are very few gaps to close.

Mastery approaches to mathematics and the new national curriculum NCETM October 2014

If a pupil fails to grasp a concept or procedure, this is identified quickly and early intervention ensures the pupil is ready to move forward with the whole class in the next lesson.

The Essence of Maths Teaching for Mastery NCETM June 2016

The team of Babcock LDP mathematics advisers worked on a research project related to teaching for mastery during 2015/6 and an alternative way to provide additional time was identified by some of the teachers involved: pre-teaching. The project also explored 'complex instruction' and in particular the idea of assigning competence in order to raise the status of certain children in mathematics lessons.

Elements of quality first teaching were highlighted during the project as having a particular part to play in supporting teaching for mastery in a mixed-age class. These were:

- *...Pre-teaching used to support children so they could engage with the mathematics in a sequence, assigning competence...*

Pre-teaching was one strategy used to support children who might otherwise struggle to access the mathematics in a lesson. Several of the teachers in the project used this for particular groups and individuals, in order to help the children work towards age-related expectations and support them to 'move through...at broadly the same pace'.

Teaching for mastery in mathematics in mixed-age classes: final report Trundle et al 2016

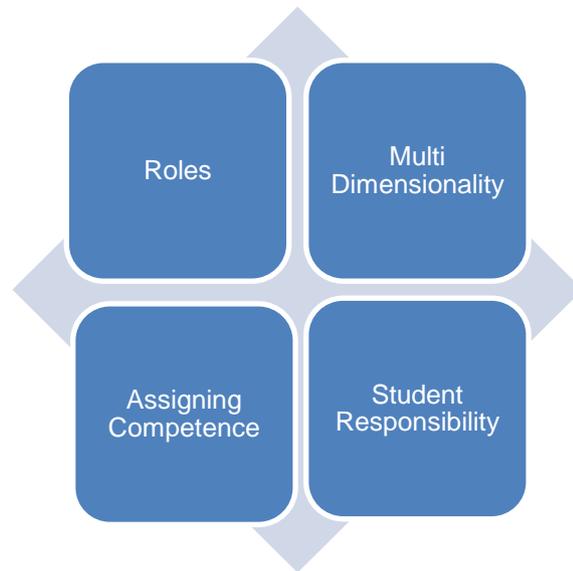
The interest in pre-teaching and assigning competence, generated by the 2015/6 project, the potential for using these approaches to support children who struggle to be involved in maths lessons and the limited existing research, particularly into pre-teaching in mathematics, led to this project being set up. The key research question for the project was:

How can pre-teaching and assigning competence be used to effectively support children to **access age-appropriate mathematics** and **be active and influential participants in maths lessons**?

Assigning Competence

The notion of assigning competence comes from the work of Cohen, Lotan and others at the Stanford School of Education. They developed an approach called 'Complex Instruction' which aims at achieving equity in co-operative learning classrooms.

Jo Boaler (2015) used the work of Cohen and others to explore how 'complex instruction' could be used to support equity in mathematics classrooms. She identified four aspects of complex instruction:



Assigning competence, one of the four aspects of complex instruction, is explained as:

... raising the status of pupils who they think may be lower status in a group – by, for example, praising something they have said or done that has intellectual value and, bringing it to the group's or the whole class's attention. (page134)

Mathematical Mindsets Boaler 2016

Cohen, Lotan et al explain that:

Teachers can assign competence to any student but it is especially important and effective to focus attention on low-status students. Cohen and Lotan found that status interventions boosted the participation of low-status students, while not suppressing the contributions of high-status students. These positive effects occurred despite the low overall frequency of teacher's use of status treatments.

*Complex Instruction: Equity in Cooperative Learning Classrooms
Cohen, Lotan, Scarloss and Arellano 1998*

There are key aspects to assigning competence. It is not about praising a contribution just because it has been made; it has to be of value to the whole group.

Cohen (1994)...recommends that if student feedback is to address status issues, it must be public, intellectual, specific and relevant to the group task. The public dimension is important, as other students learn that the student offered the idea; the intellectual dimension ensures that the

feedback is an aspect of mathematical work; and the specific dimension means that students know exactly what the teacher is praising.

Mathematical Mindsets Boaler 2016

The importance of assigning competence within this project was two-fold; it seemed to have the potential for supporting children to be actively engaged by identifying significant contributions they were making to everyone's learning and it could be used to directly link the pre-teaching to the lesson. Too often, when children are given 'additional time', especially when it is through some form of intervention, it does not directly benefit learning in the class lesson because the children experience the intervention and the class maths as separate and distinct episodes of learning. The reason for focusing on assigning competence alongside pre-teaching was to overcome this issue and replace disconnection with explicit connection.

Pre-teaching

Remediation is often a terrible way to help kids catch up. Pre-teaching is more effective and more fun...For the same 20-minute investment of time, we can change the way a child sees himself as a reader, thinker, or mathematician. We can give Manuel the rare experience of being the kid who gets it first, who helps the other kids figure it out, who is ready with the answer the moment he hears the question.

For children accustomed to struggle, those moments can be transformative. They can make reading an act of pleasure instead of torture. Math can become fun instead of frustrating. The feeling of confidence can linger long after the class has moved on to the next concept.

Why I Prefer Pre-Teaching to Remediation for Struggling Students Minkel 2015

Research into pre-teaching, and specifically pre-teaching in relation to mathematics, is limited and there is no exploration of different types of pre-teaching. During this project we were interested in:

- Different structures for pre-teaching
 - Do sessions need to be of a certain length?
 - How often do they need to happen?
 - When do they need to happen in relation to the maths lesson?
 - Do they need to happen at the same time on the same days?
- Different content for pre-teaching
 - For what do the children need extra time?
 - Does the content need to replicate the lesson or is it for rehearsing prior understanding?
- How to assign competence in maths lessons, linked to the pre-teach
 - How does pre-teaching allow teachers to assign competence?
 - What are the best ways of assigning competence so that status is shifted?

Overview of action research project

Project sample

For this project, teachers from 19 schools were invited to participate. During the year, two schools had to withdraw due to personal circumstances, leaving 17 schools involved for the full year (see table 1). The teachers involved taught from Y1 to Y6 but the majority of the teachers taught in the middle years (Y3 and Y4); the split was KS1 20%, lower KS2 57%, upper KS2 20% plus one class with mixed Y4/5.

Table 1

Name of School	Location: City, town, village	Number on roll	Age range	Classes involved in project
Ashleigh C of E (VC) Primary School	Town	248	3 - 11	Y3 Y3
Bovey Tracey Primary School	Town	292	4 - 11	Y3/4 Y3/4
Countess Wear Community School	City	389	2 - 11	Y2 Y3/4
Dartington C of E Primary School	Town	259	3 - 11	Y4/5 Y6
Great Torrington Bluecoat C of E Primary	Town	532	2 - 11	Y2 Y2
Ilfracombe C of E Junior School	Town	467	7 - 11	Y4 Y4
Newton Ferrers C of E Primary School	Village	137	5 - 11	Y3/4 Y3/4
Sidmouth C of E (VA) Primary School	Town	514	2 - 11	Y1 Y3
St Margaret's C of E (VA) Junior School	Town	212	7 - 11	Y4 Y6
Stoke Hill Nursery and infant school	city	320	3 - 7	Y1 Y2
The Castle Primary School	Town	320	4 - 11	Y3/4 Y3/4
The Erme Primary School	Town	116	4 - 11	Y2 Y6
Two Moors Primary School	Town	413	3 - 11	Y3 Y3
Whipton Barton Junior School	City	246	7 - 11	Y3 Y4
Willowbrook Primary School	City	413	3 - 11	Y2 Y3
Woodlands Park Primary School	Town	309	4 - 11	Y5 Y6
Woolacombe School	Village	240	2 - 11	Y3 Y6

Head teachers were asked to identify two teachers who were interested in researching this area and would be prepared to try things out, reflect on their observations and share their thinking with other teachers and advisers. The teachers selected for the project included leading maths teachers, maths SLEs and senior leaders; in five of the schools these mathematics 'experts' were an additional teacher supporting the project and working with two selected class teachers.

Project structure

The project was supported by five maths advisers from Babcock LDP. For the maths advisers the project was part of a focus on closing the gap, a priority for Devon and funded by Devon County Council. The funding for the teachers was provided by two maths hubs, Jurassic and Cornwall and West Devon (CODE).

Each school had either a pair or a trio working together as learning partners. These pairs/trios were then grouped to form five geographical clusters; the clusters ranged from two schools to five schools (two, three, three, four and five). Each cluster was supported by a maths adviser.

Teachers were asked to identify three focus children for the project; closing the gap (and therefore pupil premium) was one of the key drivers for the project and teachers were encouraged to identify vulnerable children as their focus children. The teachers worked with their focus children throughout the year using pre-teaching and assigning competence to increase their active participation and influence in maths lessons.

Schools received detailed information about the structure and expectations of the project (see Appendix 1) as part of the invitation to participate; the structure is outlined below (table 2).

Table 2

Autumn term – first half	Webinar for head teachers and senior leaders
Autumn term – first half	Project launch meeting
Autumn term – first half	Data collection
Autumn term – first half	Cluster meeting 1
Autumn term – second half	CLR cycle 1
Autumn term – second half	Cluster meeting 2
Autumn term – second half	Cluster meeting 3
Spring term - first half	CLR cycle 2
Spring term – first half	Cluster meeting 4
Spring term – second half	CLR cycle 3
Spring term – second half	Cluster meeting 5
Summer term – first half	Cluster meeting 6
Summer term – second half	CLR cycle 4 – joint live lesson
Summer term – second half	Project conclusion

Webinar

In order to maximise the involvement in and impact of the research project, all head teachers were invited to participate in a briefing webinar. In the same way that connecting additional maths sessions, which involve only some children, with classroom lessons is essential if the additional time is to be beneficial;

connecting additional professional development, which involves only some teachers, with the ongoing professional development in a school is essential if it is to have maximum impact.

Project launch meeting

The launch meeting was the start of data collection. Data included:

- Questionnaires pre- and post-project with video of focus children answering questions. Teachers also completed questionnaires pre- and post-project and were videoed at the end of the project talking about the impact.
- Engaging with a maths question – focus children explored a maths question in their trios and this was videoed.
- Journals – both teachers and children were provided with journals to use throughout the year.
- Observations – teachers made many of their observations from pre-teaching, everyday maths lessons and research lessons in their journals.
- Live research lessons – plans, observations, notes from follow up discussion and video were all used to capture information from the live research lessons.

The launch meeting explored the key principles and research underpinning the project and included reading the Cohen, Lotan, Scarloss and Arellano(1998) article *Complex Instruction: Equity in Cooperative Learning Classrooms* and the Minkel (2015) article *Why I Prefer Pre-Teaching to Remediation for Struggling Students*.

Cluster meetings

The cluster meetings provided an opportunity for small groups of teachers from different schools to meet, to share their experiences of pre-teaching and assigning competence, to explore ideas from related research and to plan their next steps. They also provided some of the planning time for the collaborative lesson research cycles.

Collaborative Lesson Research

The teachers were all involved in four cycles of collaborative lesson research; three in their schools and one joint one which took place in one of the schools.

The model for the CLR cycles was based closely on the Japanese model.

Collaborative Lesson Research is a form of Lesson Study using live lessons to answer shared questions about teaching and learning. We define Collaborative Lesson Research (CLR) as having the following components:

1. *A clear research purpose*
2. *Kyouzai kenkyuu*
3. *A written research proposal*
4. *A live research lesson and discussion*
5. *Knowledgeable others*
6. *Sharing of results*

Collaborative lesson research: maximizing the impact of lesson study Takahashi, and McDougal 2016

For the three cycles of CLR that took place in each school, the pairs/trios of teachers had at least two planning sessions to explore the mathematics and create the detailed research proposal for the live pre-teach session and for assigning competence in the following live maths lesson, often with further readings to consider between the meetings. This was part of 'kyouzai kenkyuu' which involves teachers exploring their own understanding of the mathematics that is the subject of the proposal, and then designing the live session built on a shared understanding.

The maths advisers acted as the 'knowledgeable others' and encouraged the teachers to choose an element of mathematics with which all the children in the class would struggle so that there would be real value to assigning competence during the lesson following the linked pre-teach. Once the focus for the lesson was chosen, the teachers identified the difficult parts of the mathematics, i.e. what would make the children struggle, anticipated responses and explored how to deal with these in order to support understanding, using the readings to inform their thinking.

Anticipating is the first of the five practices identified by Stein et al (2008) that help teachers to orchestrate productive mathematical discussions and these five practices informed the planning of the research proposals for the live sessions:

- *Anticipating*
- *Monitoring*
- *Selecting*
- *Sequencing*
- *Connecting*

Orchestrating Productive Mathematical Discussions: Five Practices for Helping Teachers Move Beyond Show and Tell
Stein et al 2008

This then led to a detailed proposal for the live pre-teaching. Appendix 2 has an example of a research proposal for a live research pre-teach session. Observation of the live sessions involved all who had been involved in the planning the research proposal, with one teacher teaching the session. The focus for the observations was on the impact of the joint decisions made during planning; this was discussed after the live sessions. The focus children were also asked to reflect on the lesson and the way the pre-teaching had helped them and this was included in the discussion.

Joint live session

The final cycle of CLR brought all the teachers together with the five maths advisers. The focus for the live session was decided by the trio of teachers from the host school and the research proposal was drafted by the maths advisers with the teacher who would be teaching the lesson. The draft proposal was then shared at the cluster meetings allowing all the teachers to contribute, in particular anticipating responses and suggesting how to deal with these. The live session took place in the school hall so that all of the project teachers could observe. The plan for this live session is included in Appendix 3.

Project conclusion

In advance of the final meeting, teachers gathered end of project data and prepared a case study on one of their focus children. Examples of case studies can be found in Appendix 4.

Research Findings

Impact on learners

Pre-teaching is more effective than remedial teaching. Assigning competence is more challenging but when effectively done can be transformative – Y6 teacher

Both teachers and children involved in this project reported that it has had a huge impact on levels of participation and the ability to be influential in lessons. For many of the children it has not only allowed them to access age-appropriate mathematics, it has also had a positive impact on their attainment in tests.

“It must be the teacher” - Y4 teacher

The most important factor in terms of the impact was that the pre-teaching was run by the class teacher. This meant the children knew that the teacher knew they knew the mathematics going into the lesson because they had been in the pre-teach session together. There was also a sense of the children wanting to work hard in the lesson because they had been given the extra small group time with the teacher. This had an impact on participation. The same would not be the case if the session was not run by the class teacher.

This additional time with the class teacher was seen as a privilege by the children, rather than something to be disappointed about having to do. It was something that was enviable within the class.

“It’s more than just maths. It’s the process of building engagement and self-confidence” - Y2 teacher

This is in stark contrast to the attitude towards remedial interventions run by someone other than the class teacher. An issue that was raised early on was the status of interventions in schools and how this has a knock-on effect in terms of the status of the children attending the interventions. For some of the older children, initially, they were unhappy at having been identified for the group but this soon changed when they realised this gave them time with their class teacher and that this helped raise their status in the maths lessons.

The main challenge has been totally rethinking the way that I see intervention working in my class - Y6 teacher

For the teachers it allowed them to really get to know the children, their ways of thinking and how to get the best from them and this then transferred to the classroom:

I feel I know my children far better in terms of what interests them and how they learn which has enabled me to engage them better in the class lesson - Y3 teacher

Now I really know why they are not on track – Y6 teacher

It also provided teachers with an opportunity to reflect on the planned lesson in advance, as the pre-teaching often revealed things which prompted adjustments to make the lesson more effective; in effect it was a pre-teach for the teachers as well as for the children, both of whom were then more focussed at the start of the lesson.

Confidence

An increase in confidence was the most common comment made by the participating teachers about their focus children. Confidence is difficult to measure but it is possible to look at the effects of an increase in confidence. The main effect was increased participation in the class lesson, and an understanding of how to participate as a learner in different situations; indicated by various changes in behaviour including:

- Engagement from the start of the lesson

So much time is wasted at the beginning of a lesson if a child starts behind. When other children have a better understanding of a concept, they immediately start making progress. One child spoke of feeling muddled while everyone else knew what they were doing. It strikes me that the gap is widened at the very beginning of lessons, before teacher intervention, because the playing field isn't level for children with shaky prior knowledge - Y6 teacher

Many of the children commented on how pre-teaching provided them with access to the lesson whereas previously they had felt excluded from the lesson as they didn't understand what was going on from the very start. One Y3 child expressed this as being boring: *"I hate maths, it's boring...It's not boring when there's been a pre-teach. If there hasn't, it's boring because I don't know what I'm doing"* whilst a child in Y6 observed *"Before I had the pre-teach I felt I was entering lessons half-asleep but now I feel I am wide awake."*

This does not mean the children did not struggle in the lessons; in fact they were better placed to engage in struggle in the lessons because additional barriers had been removed. The purpose of the pre-teach is to address the barriers the children might have in accessing the mathematics in the lesson, rather than to avoid having the children struggle in the lesson.

An assumption underpinning this work is that all the children in a class could struggle with the mathematics in a lesson; with pre-teaching the teachers are considering the additional barriers that their focus children might have in accessing this struggle. In this way, pre-teaching can provide children with the possibility of getting to a solution or working right to the end in a maths lesson which, otherwise, they would not have been able to do.

A useful analogy is the handicap system in golf. The idea is that players can play each other and have an equal chance of winning, even if some of them are more experienced than others, by allowing some players additional strokes. In the same way, pre-teaching allows the focus children a chance of achieving the aim of the maths lesson at the same time as the rest of the children in the class by allowing them some additional time in advance of the lesson.

There were many comments from the children at the end of the project, indicating how pre-teaching helped them to be engaged:

Having a sneaky preview of the lesson gives me a head start and if I didn't have that I wouldn't be ready – Y3 child

It made my maths better because it gave me a head start - Y3 child

So we know what's going to happen before we actually do the lesson, it's like it's much easier for us. It's a bit like a secret that we know - Y2 child

I feel sort of clever because I already know what we're going to do in the lesson and it makes me feel happier about talking about things with everyone else. – Y2 child

It helps to know what is coming up. When I go out [of the pre-teach] I feel I can be part of the lesson – Y3 child

...turning my brain on in the morning...helps you warm up before maths so I'm ready for it...gives you a jump start –Y6 child

This was summed up by a year two teacher who wrote:

If you step back from the case study research and think about the overarching principles of pre-teaching it highlights what is a very obvious principle, that 'to be forewarned is to be forearmed'. If we give children the space and time to explore a new concept in detail, we provide them with a sense of empowerment through new found knowledge which enables them to take control and ownership, bolstering their self-esteem and confidence.

- Offering contributions and ready to respond
"I always put my hand up now even if I am not one hundred percent sure as I want to know if I'm right or not" Y4 child

A very obvious way that teachers reported increased participation was observations of the children offering responses during class lessons and the children themselves reflected on this at the end of the year. This demonstrated a shift in attitude and resulted in positive feedback for the children which then led to further participation.

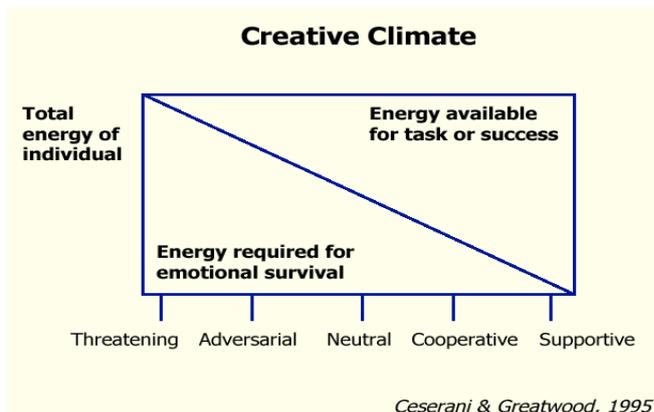
All children were engaged in the input and had their hands up from the start, answering questions and offering suggestions...all children chose to challenge themselves with the harder activity –Y3 teacher

During the main session R was quick to put her hand up and explain what she had noticed in the pattern of the numbers written on the board...she beamed with joy as peers acknowledged her accurate observation...They were excited about what they knew and could share with the whole class using the sentence starter 'I noticed that...' – Y2 teacher

Before I just sat there doing nothing and was unsure. Now I'm like PICK ME because I feel more confident. - Y3 child

- Asking different questions and seeking out a challenge

Engagement from the start of the lesson and an understanding of the focus of the lesson puts the children in a position where they are able to think more mathematically **in** the lesson because they are less anxious and are therefore paying less attention to their emotional wellbeing. This links to an idea suggested by Ceserani and Greatwood, that a creative climate has two competing elements that consume the energy of an individual. The more energy required for emotional survival, the less energy there is available for the task faced (see diagram below). By reducing the energy required for emotional survival in the maths lesson, pre-teaching provided the focus children with more energy to focus on the mathematics.



This resulted in the children being prepared to ask questions that focused on the mathematics, rather than emotional reassurance, for example “I wonder if...” rather than ‘Is this right?’, and to want to tackle challenging mathematics. This indicates an increase in the willingness to take risks and learn from mistakes.

Before: ‘Seeks reassurance, looks for help even when doesn’t need it’ After: ‘She works independently not always coming up to me for approval. If she does come up to me it is usually to explain the maths e.g. I am wondering if...can I see if it works with...’ – Y3 teacher

The children were excited to choose challenging numbers. Children said: “I am going to go for the trickiest” and “I am going for the challenge as well.” – Y4 teacher

- Accessing resources independently

Teachers noted that the children had a better understanding of how to use things available in the classroom to support their thinking during the lesson because they had experienced them in the pre-teaching and this enabled them to be more successful in the lesson. This included children using: their pre-teaching journal as an aide memoire; working walls; and maths equipment.

C referred to the working wall for the definition of an obtuse angle; he had put the label there in the previous lesson after a pre-teach session - Y3 lesson observation

Maths group helps me because I know what is coming up. I feel more confident to have a go. If I forget I can use the working wall or the resources we used - Y4 child

Equipment helped me see things - Y3 child

There has been quite a few times [L has helped me]... we talk about ideas together and she shares her ideas with me. She sometimes draws pictures if I don’t know what she means to help me - Y6 partner of a focus child

- Explaining thinking

Pre-teaching had a big impact on the focus children's ability to explain their thinking. With such a small group for the pre-teaching there was inevitably going to be a lot of opportunity for each child to speak and to be heard. Teachers used various strategies for supporting the talk in the pre-teach sessions, conscious of the importance of language to learning:

Language is a huge barrier to success. It has also been refreshing to see the small amount of time that is required to make a significant impact within a lesson. A short pre-teach session (as little as five minutes) may be enough to allow a pupil with limited vocabulary to access the learning and fully engage with the maths of a lesson... all children can benefit from rehearsing maths language
Y3 teacher

Child can now answer problems in full sentences and use appropriate language – Y3 teacher

Sentence starters are exciting and make me feel like I want to read out what I have thought – Y3 child

T showed me how to use the sentence starters on the wall to help me explain what I did when we were playing the fractions game - Y4 partner of focus child

Askew suggests it is important that children talk mathematics rather than talk *about* mathematics:

There is a truth to the adage that mathematics is a language and just as there is a difference between talking about Italian and talking Italian, so the vocabulary to talk mathematics becomes part of the classroom discourse – it's not a list of words that you select from to talk about and describe something else, it's becoming immersed in the mathematics talk.

Private Talk, Public Conversation Askew 2010

Johnston-Wilder and Lee also suggest that an essential part of learning mathematics is talking like a mathematician and that one of the effects of this is that it builds resilience.

That is, an individual takes on the identity of a mathematician, someone who 'knows mathematics,' by learning how to talk like a mathematician. If pupils are not given the opportunity to 'talk like a mathematician', their mathematical education is impoverished...Where pupils develop resilience, through a talking and learning classroom, they can deal with the difficulties inherent in understanding mathematics.

Does Articulation Matter when Learning Mathematics? Johnston-Wilder and Lee 2008

Many of the children commented positively on how they now felt able to explain:

I explain it to him [partner] so he knows what to do - Y3 child

I like doing this. It's like we are teachers too because we are explaining to people – Y3 child

I can say things in more detail now - Y3 child

...after I've said something and everyone is looking at me I feel proud of myself – Y2 child

Now I feel more confident and can speak because people listen – Y3 child

She explained it to me really well and showed me examples of when it is a good time to use it – Y6 partner of focus child

She won't let me go until I fully understand. She would go through it with me and at the end she would ask me questions just to make sure I get it – Y6 partner of focus child

Once we've done a pre-teach session and I go back to my learning, it's easier. It helps to explain it to someone because you know and they don't and then it helps you understand it even more when you explain it to them – Y6 child

As identified by the year six child above, one of the benefits of being able to explain is that it deepens understanding. So the benefit is more than simply that the children are able to explain; it is that by being able to explain they are able to examine their own thinking, deepen their understanding and therefore learn more. The focus children were getting a chance to explain in the lesson that might not have happened without pre-teaching; previously they may have listened to others explaining to them. They were now being provided with an additional learning opportunity.

Increased participation in lessons has the natural consequence of the focus children being more **influential** in the lessons. Being able to explain is one of the key ways of influencing others and puts the children in the position of being able to support others.

- Supporting others

For some of the focus children it was a revelation to find that other children in their class struggled with bits of maths and that they could be in a position to help these children. They used different strategies, which they had experienced in the pre-teaching, to help their partners not just do the maths but understand the maths. This included using resources, drawing and explaining.

Now I can show others how to do it when before it was me who needed help – Y4 child

I knew I didn't know very much – now I'm the teacher I know what other's don't – Y3 child

I know what I'm doing now. I can help to help other children – Y3 child

I can help others by the things I now say in class – Y4 child

It helped me by teaching other people. Sometimes I don't teach others but after pre-teaching I can – Y3 child

Not nervous when I'm an expert because I know I can definitely help others – Y3 child

It wasn't just in his head. He actually showed me how to work it out. He showed me more than once which helped me remember it all – Y3 partner of focus child

She helped me with divisions, she helped me understand because I didn't know what division was and she explained – Y3 partner of focus child

Focus child volunteered to help another child, who has been absent, to 'catch up' – Y4 teacher

He wouldn't tell me the answers he would tell me to try different ways – Y3 partner of focus child

When I got really stuck before I'd ask you but he helps me out now instead – Y3 partner of focus child

At the start of the project some teachers employed very explicit strategies to involve the focus children in explaining to other children in the class. However, once the children were comfortable with explaining their thinking and had demonstrated this in the lessons, they then chose to take on the role of supporting others. Other children would also seek them out, recognising that they had a good understanding of the mathematics, without prompting by the teacher.

I know to ask her to help me because she knows it quicker after being with you. I feel she knows a lot more now...and I can rely on her to help – Y3 partner of focus child

On the carpet M showed her partner how to work out change by using a number line. Her partner listened to her and then used the method during the next example – Y3 teacher

I wasn't put in her group after the 'I wonder...' so I asked if I could change groups to work with her. I didn't know how decimals worked so I didn't know 3.2m was more than 3.19m. She proved it with base ten – Y4 partner of focus child

This included high-status children choosing to go to the focus children for support, which had a real impact on the status of the focus children in maths lessons.

Another child that typically holds higher status immediately turned to N when they were given time to talk in groups about what the pictures showed. N began pointing at the picture and talking whilst the others listened - Y3 teacher

I have never felt like it, I can't believe G needed me in maths – Y3 child

High status child explains in the plenary that W helped them to find a right angle. W had spotted they were measuring the outside of an angle and showed them how to measure – Y3 teacher

- Active participation in conversations

Another indicator of increased confidence and participation was the shift from being a passive member of a group or pair to being an active member, prepared to start conversations about the mathematics.

I now talk to everyone, not just Miss – Y3 child

I believe that when working in a partnership I am more equal in ability and understanding...it helps me to understand more if I can explain it to someone else – Y4 child

This seemed to be because the children now believed they had something valuable to offer, something that was worth others listening to and thinking about. This led to the focus children making more considered responses in discussions:

He thinks now and doesn't guess so I listen more – Y3 partner of focus child

He used to agree with everything I said but now we have discussions about the maths – Y3 partner of focus child

Before “Shouts out random answers without giving it any thought or attempting to use a strategy to work out an answer” After “He gives himself clear thinking time and would rather take longer to get to the right answer than to be quick with the wrong answer” – Y3 teacher

This has also meant that the focus children have been willing to challenge others, including high-status children, and defend their thinking:

At first I didn't believe her so she showed me a few times, then I tried it and I saw she was right. Then me and N explained it to the group together – Y3 partner of focus child

I tried to show her something but she didn't believe me. Then I explained to her and then she believed me and changed her mind. It made me feel good because I helped someone – Y3 child

When we were doing maths talk I had two ways in my mind but J's was completely different to my methods. That made me change how I was thinking about it – Y3 partner of focus child

At the start of the year: “Dependent on others and passive in groups situations.” At the end of the year: “She listens to her peers but if she disagrees with them she will explain why until she has convinced them of her reasoning.” – Y3 teacher

Impact beyond maths lessons

Changes in behaviour and attitude have been observed not only by the class teacher in maths lessons but also by other members of staff and by parents. Many of the teachers spoke about parents actively sharing how they had noticed positive changes in their child and that the changes went beyond mathematics:

A's parents have noticed a significant difference in his engagement at home and his ability to think before speaking. They have been very supportive and reminded him to 'think then speak' when answering any questions – Y3 teacher

Her parents have mentioned that she is excited by maths now and enjoys the groups. They really value the time being spent with her – Y4 teacher

Mum had recently discussed the progress her child has made in maths and believes they have become more confident in their ability. Mum also mentioned an improved attitude towards learning – Y4 teacher

Mum has commented a few times on how much she is enjoying her learning now and how she talks about our 'maths group' – Y3 teacher

She is a different child. She talks about what she has been doing in maths at home. She is keen to practise skills at home – parent of Y1 focus child

B's mum has said he is a lot happier around his maths and she has noticed a big change in his attitude towards it. This has been apparent through their daily discussions and his homework – Y3 teacher

Case studies outlining the impact on individual focus children are included in Appendix 4.

Pre-teaching

It's not a remedial thing and they are not therefore missing out on anything else that the other children are getting to do so they don't feel like they're being punished by being removed from things because they weren't good at something they've already done. They've not even tried it yet so it's boosting them before they've even got there...we've had a couple of children involved in our sessions that have been on IEPs so our SENCo has talked to them about the impact and the findings she's had as well were really positive, in comparison to other interventions to the point where they couldn't really even remember any of the other interventions that they'd had but this one was something that they talked about really positively – Y6 teacher

In the introduction, Bloom's thinking about Learning for Mastery is referenced and one particular phrase identified as key to this research project: '*...the assumption that, given time, enough, all students can conceivably attain mastery of a learning task*' (*Learning for Mastery* Bloom 1968). We identified that the phrase '**given time, enough,**' contains a challenge; the challenge of providing additional time for children who need it in a form that will maximise impact whilst minimising disruption to the rest of their learning.

By having class teachers provide the 'additional time' and putting it before the learning happens in a maths lesson, rather than after it, children have been provided with even more additional time and opportunities for learning than the time in the pre-teach. This is because the children are better able to access the learning opportunities in the lesson and talk about the mathematics in the lesson (deepening their understanding) whilst teachers are better placed to support the learning in the lesson.

*Ten minutes pre-teach means you get ten minutes **and** the whole lesson of engagement instead of losing the whole lesson in order to access intervention – Y3 teacher*

"Pre-teaching has given me confidence to say more in class. It helps me in class because we go through it again and it's much clearer – Y3 child

Pre-teaching has helped me because I know what I am doing and understand it easier. As I have been taught it twice I am not sat there not knowing – Y4 child

Pre-teaching has more immediate and greater impact than catch up – Y3 teacher

So, by becoming active participants in the maths lesson, the children are able to learn within the lessons in a way they were not able to previously. In addition to this, they are able to engage in activities in the lesson that further their learning and deepen their understanding. In *Teaching for Mastery: Questions, tasks and activities to support assessment* (Askew et al 2015) things a pupil can do if they really understand a mathematical concept, idea or technique are listed (adapted from a list in *How Children Fail* Holt 1964):

- *Describe it in his or her own words;*
- *Represent it in a variety of ways (e.g. using concrete materials, pictures and symbols)*
- *Explain it to someone else;*
- *Make up his or her own examples (and non-examples) of it;*
- *See connections between it and other facts or ideas;*
- *Recognise it in new situations and contexts;*
- *Make use of it in various ways, including in new situations*

The changes of behaviour identified by teachers in the previous section included the first three of these; in other words the focus children were now describing the mathematics in lessons in their own words, explaining it to someone else and choosing to represent the mathematics in different ways to help others understand. They were now able to engage in activities in the maths lesson that both deepened and demonstrated their understanding and understood better how to participate as learners in different situations.

Focus

For pre-teaching to be successful, it must give children access to the mathematics in the maths lesson, allowing them to actively participate. It is not about being able to replicate in the lesson the maths from the pre-teaching nor is it about teaching the whole lesson in the pre-teach session. This is neither possible nor desirable. Focussing on only one thing when pre-teaching makes it more effective:

Be specific – think carefully about the purpose of the pre-teach - Y6 teacher

Needs to be very specific and try not to include too much – Y3 teacher

It is about identifying what will allow the children to access the mathematics in the lesson. This includes:

- Introducing new mathematics, new contexts and new contextual resources
- Rehearsing prior learning
- Rehearsing language
- Allowing confusion to happen
- Using misconceptions
- Using images/resources (especially for the first time)

Structure

There is no one way to make pre-teaching work. It does not have to be of a certain length nor does it have to happen at a certain time; both of these vary according to the age of the children, the needs of the individuals and the demands of the mathematics. However, there are things to consider:

- Most teachers found that having the pre-teach session on the same day as the maths lesson worked best although some did it at the end of the day in advance of the maths lesson on the next day. Some teachers liked to run the session immediately before the lesson whilst others liked a gap as it allowed them time to reflect on how they might want to adjust the lesson in light of the pre-teaching.

Pre-teaching is invaluable for finding out children's misconceptions before moving on to full class teaching – Y3 teacher

Pre-teaching in maths allows the children to immerse themselves in new learning for the day – Y2 teacher

- Teachers varied in terms of how frequently they used pre-teaching but at least weekly seemed to work best. As this research project was focussed on vulnerable children there was a need to provide them with some sort of consistency; regular sessions, at least in the early part of the year.

These children benefited from being involved for the whole year; flexibility may be important in terms of making pre-teaching work in the long term with the option to vary at least some of the children who are involved, but the impact on the focus children in this project relied on their sustained involvement in the pre-teach sessions for the full year.

What made the biggest difference? Time in a small group on a regular and sustained basis - Y5 teacher

If it's really planned in then it works – Y6 teacher

Don't have to have a set time or day to run the pre-teaching – go with the needs of your children. One minute before a session can be enough for a child to access the maths - Y2 teacher

- The length of pre-teaching sessions varied. Some were fifteen minutes in length, others just a few minutes; sometimes knowing when to stop the pre-teaching became an important decision. Time needed depended partly on the focus of the pre-teaching but the important thing was clarity about the purpose of the session.

A fairly small amount of pre-teaching can have a noticeable and long lasting impact (children had a 10 min pre teach for one-off fraction lesson in spring term 1 and remembered language and context in spring term 2) - Y3/4 teacher

A short sequence of pre-teaching can develop confidence over a longer period – Y3 teacher

Some children just need a quick input to allow them to approach the lesson with confidence. Giving them a slight input before others has ensured that I spend less time with them in the classroom which again increases their confidence – Y3 teacher

Even a short pre-teach session of one or two minutes can have an impact on the focus children in the main lesson - Y3 teacher

Teachers identified that as they worked on pre-teaching throughout the year they adjusted their approach and started to consider whole school implications:

As my practice developed I became more aware of what needed to take priority and my pre-teaching was more focused and purposeful. I also improved in my pitch of questioning and who to ask which questions – Y4 teacher

I have never used pre-teaching before, now value its impact especially in maths and we are trialling it in English – Y6 teacher

Assigning competence

There was a moment where, I thought this was a real watershed moment, when the children involved in the pre-teaching started to present as the drivers of the lesson and I started to think we need to start changing this because there are children now who need my support and it's not the same kids that it was in the first place – Y5 teacher

Increased participation and access to the mathematics lesson allowed the focus children to become more influential. Across the duration of the project, assigning competence became easier because the children were contributing more and were focussed on the mathematics rather than on their emotions.

Assigning competence is about drawing attention to a child's thinking that everyone can learn from rather than drawing attention to a child by getting them to perform. It is about being explicit about the child's contribution that is of intellectual value. Observations about how to make this work include:

- Be subtle – it is not about a performance or memory test – don't over-question in class:

Assigning competence needs to be an organic process - Y6 teacher

Simply explain to the children that they are able to take part and offer ideas/explanations at any point during the main session. Provide opportunities for them to contribute but don't signpost to specific children in an overt or clunky way - Y2 teacher

- Comment on the thinking/idea not the child. It is not about effort, it is about the quality of thinking, thinking that is of intellectual value:

I have recognised the importance of praising these children for real and meaningful reasons which have mathematical backing rather than just praising effort - Y3 teacher

C suggested changing 83 seconds to 1 minute 23 seconds. I called it C's strategy and then referred to this at various points - Y3 teacher

- Use simple phrases, such as:

"X is onto something important there, let's look at it" – Y4 teacher

- Anticipate and monitor – two of the five practices explored in the introduction (Stein et al 2008):

Wandered until I saw that E had chosen sensible Cuisenaire - Y3 teacher

You can see she disagrees and for her to speak she usually has to be asked 'Do you agree?' to which she will reply 'No, because...' and then she goes into her explanation - Y3 teacher

- Support other children to publicly state how they have been helped:

Asking "Who can tell me some helpful advice someone told to you" in one class led to two children from a class explaining how two children from the pre-teaching group gave them advice – Y3 teacher

Since thinking about assigning competence I have been asking children to explain what somebody in the class taught them and to name that person so as to make a bigger point of celebrating their idea - Y3 teacher

The most powerful way to assign competence is to do it through another child. This then becomes normal procedure for pupils to acknowledge one another and when they have supported one another and generates a supportive classroom environment - Y3 teacher

- Subvert hierarchies that exist in the classroom

One particular lesson was an attitude changing session. During the whole class input, following pre-teaching, she had her hand up for every question and we had to jokingly ban her from answering any more questions. The class thought this was great and it raised her status within the groups as the go to person for an answer. It was something we often refer back to which maintains her status within the group - Y3 teacher

- Attend to classroom culture and school culture. If there is a talking for learning culture it is easier to assign competence as talk is already valued.

Impact on teachers

The research project has been a year-long professional development experience for the teachers involved. It was designed with specific elements to support ongoing professional development (journals, cluster meetings, collaborative lesson research cycles, research readings etc.) alongside the professional development that comes from carrying out action research in the classroom, in this case experimenting with pre-teaching and assigning competence.

Collaborative lesson research (CLR) was the planned element most identified by the teachers as having a beneficial impact on them. This was because of the opportunity it provided to really unpick what is involved in teaching and learning a small piece of mathematics. The 'kyouzai kenkyuu' phase of CLR was something that many of the teachers said they do not often get the chance to do. It was important that the collaborative lesson research was planned into the school day, so that it was valued as professional development, and that it included the support from a 'knowledgeable other':

We found the planning bit was fascinating...it's really unpicking it... We are doing the most learning through the planning – Y6 teacher

CLR cycles have had the greatest impact on allowing myself and colleague time to talk about maths in depth, really focus on our planning and observe children in great detail – Y3 teacher

I really enjoyed the lesson research cycles...particularly when I was able to sit back and observe the children in my class and see what other people noticed about them – Y6 teacher

Thinking carefully through the decisions we were making for the lesson study, the associated reading and the reflections associated with the observed lessons deepened my understanding of key pedagogical ideas – Y5 teacher

Through the deep attention to detail when planning collaborative lessons I have learnt to think carefully and plan questions to ask as well as lesson content – Y4 teacher

Time to plan every aspect has made a huge difference to the thought put into each element of the lesson, a luxury that we don't normally have but I think is vital for key impacts to be made – Y5 teacher

I have learnt many things during this experience. The most important being to take time to plan with others and discuss what you are going to do during a session as many issues/misconceptions/questions can arise from others that you may not consider when you are planning a session alone – Y6 teacher

The CLR project has been a fantastic help with my own development as it has allowed detailed discussions around teaching that may have been otherwise missed in a busy school life – Y4 teacher

For me the greatest impact has been sitting together to plan the pre-teaching and breaking it down into each step, thinking about what do they need to do first and then, by revisiting the plan and making amendments, it is really clear. Planning what you say and do – Y4 teacher

The joint research lesson was really interesting – having a joint experience with other teachers was really beneficial as it gave us a chance to clarify our thinking about the aims and outcomes of the project – Y6 teacher

Teachers also commented on other aspects of the project, including the role of the maths advisers in supporting the professional development:

The initial supported cycle with H where we had time, guidance and key research to back up our ideas was really valuable – Y5/6 teacher

Meetings with the adviser and getting her support and feedback have been the most useful things that could have happened. We received very useful advice on our daily practice and how to tweak learning opportunities to best aid ourselves for development – Y4 teacher

The cluster meetings are always useful as they provide opportunities to share ideas across a range of different schools – Y6 teacher

The cluster meetings have been very useful in having a dedicated time to reflect on 'tweaks' to practice which means my approach to pre-teaching has been more thoughtful. Seeing others' approaches has helped broaden my experience – Y6 teacher

The combination of research readings, advisory support and a colleague helped significantly within the planning process – Y3 teacher

This led teachers to identify more long-lasting impact:

Planning in groups has had a big impact on the way I have thought through lessons. I was very much under the impression that I knew what was going on in a lesson by simply thinking it through but when asked to discuss every element of it I realised there are lots of parts, such as the way the children could react, that I simply never consider. By thinking through the planning, the questions I will ask and the possible way the children might react has allowed me to think more deeply about all of my planning and ways of taking possible misconceptions and reactions before they happen. By doing this I am able to have answers and resources prepared to close any gaps in the most structured way – Y6 teacher

Having to consider the focus for pre-teaching and experimenting with this has allowed me to reflect on the process of learning that our children go through every day – Y6 teacher

My practice has developed as I can be more insightful into the potential sticky points of the next lesson. I'm able to ask key questions to unlock the nuggets of what may help them and the whole class understand – Y4 teacher

I am more aware of and plan for misconceptions. I choose numbers more carefully to elicit mistakes – Y6 teacher

I feel that my subject knowledge has increased considerably...I feel much more confident delivering lessons that match learning objectives for Y3/4 – Y3/4 teacher

The importance of precise language selection and helping children to rehearse and repeat phrases to support their understanding – Y2 teacher

Pre-teaching has become an integral part of my teaching of maths. I am beginning to embed ways of assigning competence in lessons – Y6 teacher

Implications, limitations and challenges

This has been a small-scale project; there is a need for the further research on a larger scale, with more teachers, especially KS1 teachers as 80% of the teachers and children involved in this research project were from KS2. Due to the different systems used to measure progress and attainment in individual schools, data collected was mainly qualitative with quantitative data limited to end of key stage results for individual children and changes to end of KS2 data for each school (see page 45). Future research would benefit from collecting quantitative data on all focus children.

There is a need for research into how pre-teaching can be made to work at a school level with whole schools involved. One of the challenges is identifying when class teachers can undertake pre-teaching and this is best done as part of whole school decision-making as there are implications for timetables and management of personnel. In the schools where the head teacher has been committed to the project and fully supported the teachers involved, the project has had a greater impact than in schools where the two teachers involved felt like they were working in isolation in the school, without support from SLT.

It comes down to mindset. If a school values something, it will happen - Y6 teacher

Teachers understand and can put into practice pre-teaching sessions quite easily, once they have identified the time for them, but it is easy to lose sight of the aims of the sessions. The aim is not to deliver pre-teaching: it is to support children to be active and influential participants in maths lessons, accessing age-appropriate mathematics. Pre-teaching and assigning competence are two of the tools for doing this. The focus needs to be on the learners learning rather than the teachers doing and it is important to keep returning to this - during the project we found it was easy for attention to drift to the teachers 'doing'.

It is important, at the start, to have an expectation of both pre-teaching and assigning competence happening on a regular basis but there needs to be further exploration of how flexible this can be whilst still having an impact. For the vulnerable children identified for this project, involvement for a full year allowed them to shift both behaviour and beliefs about themselves as mathematicians and this is unlikely to happen in the short term. Some teachers introduced a level of flexibility by keeping their focus children as the core of the pre-teach group and including other children as appropriate.

Assigning competence effectively is more challenging than organising pre-teaching, but the advantage is that it can be done in any maths lesson as it does not require pre-teaching to have taken place; pre-teaching makes assigning competence easier but is not a necessity. No additional time is needed for assigning competence; it is about noticing in a different way as a teacher and drawing attention to what you notice when it is of value to the class.

Early examples of assigning competence following pre-teaching lacked subtlety and were focussed on the children 'performing'. This needs to be avoided; assigning competence needs to focus on thinking that is of value to the whole class.

Whilst an improvement in the children's abilities to explain has been linked with having an increased influence in the classroom, it is important to acknowledge that being quiet or reluctant to speak to the whole class does not necessarily mean that children don't understand and can't be influential. There were many examples of children influencing others around them in subtle ways which could easily be missed. The strategies used by teachers, to get children to identify when they have been helped by another child and how, allowed this to still be publicly recognised.

The status of intervention in some schools may need to be challenged as children may be reluctant to be involved in additional sessions whenever they happen, particularly older children, and participation may be seen as lowering status. In the project we found that pre-teaching raised the status of intervention in the school, but for some Y6 children at the beginning there was an initial negative impact because of how they viewed being involved in ANY form of intervention.

Whilst most of the children spoke positively about the benefits of pre-teaching in terms of being able to engage in the maths lesson from the start, one Y3 child did observe: "*It's a bit like cheating*". Ensuring that all children feel included and able to participate in lessons and not just the focus children was a challenging balancing act for the teachers:

It has been difficult to decide what elements of my practice to change to support certain children while not having a negative impact on the many children who are already achieving well in my class. It has been difficult to decide how to focus on certain children to raise their status in class and gain additional support while not making other children feel like their own status is being lowered or certain children are getting, what they perceive, as special treatment. A balancing act has been vital in this situation – Y6 teacher

Something I have found a little tricky is making sure I don't assign too much competence to focus children as I don't want others to switch off and assume only maths club will be picked – Y4 teacher

Collaborative lesson research has been a powerful form of professional development used as part of this project. To be effective it requires dedicated school time for all the stages, especially *kyouzai kenkyuu*, and the involvement of a knowledgeable other from outside of school.

Conclusion

Pre-teaching and assigning competence are two tools which can be used by class teachers to increase the participation and influence of low-status children in maths lessons, giving the children access to age-appropriate mathematics. Whilst they can be used as separate strategies, pre-teaching and assigning competence are more effective if used in combination. They bring together effective small group intervention, providing additional time with the class teacher for children who require it in advance of the maths lessons; and raising the status of the children within the class which brings with it increased involvement in class lessons.

Appendix 1

Information sent to schools

The details for the project are as follows:

- *The action research will be classroom based and involve case studies. Each teacher will choose three children to focus on with closing the gap (and therefore pupil premium) one of the key drivers.*
- *It is essential that both teachers in each school participate fully in all elements of the project. Full involvement includes:*
 - *Attending the launch day: 29th Sept 9:30 – 1:30*
 - *Working together, with support from a maths adviser, to run at least four rounds of collaborative lesson research. Each cycle will involve the two teachers:*
 - *planning together pre-teach sessions and how these will be linked to the maths lesson through assigning competence for the focus children from both of their classes*
 - *running the pre-teach session(s) and observing their colleague run their pre-teach session(s)*
 - *reflecting together on the pre-teach sessions*
 - *participating in their colleague's maths lesson following the pre-teach session (focussing on assigning competence)*
 - *talking to the focus children from the colleague's class following the lesson*
 - *reflecting together on the impact of assigning competence and agreeing next steps.*
 - *Continuing to work on pre-teaching and assigning competence between the collaborative lesson research cycles.*
 - *Attending five, one and a half hour cluster meetings spread across the year (approximately one each half term). These will bring teachers from the different schools together in small groups and could take place after school or during afternoons, depending on what suits the teachers and schools; this will be agreed at the launch meeting.*
 - *Keeping a reflective journal throughout the project.*
 - *Using video/audio taping to inform the case study, capturing the impact of the project on learners and learning.*
 - *Contributing to a feedback meeting, which will take place in June 2017; this will include being videoed talking about the impact of the research.*
- *As well as supporting the lesson study cycles in school, the maths adviser linked to your school for the project will visit at the start of the project to support the collection of qualitative and quantitative data.*
- *Teachers involved also need to be willing to be part of research themselves, as we will be looking at this project from a research angle in our team. We will be asking the teachers to complete questionnaires, recording discussions and collecting reflections at significant points during the year. We will provide both the teachers and children with journals as part of the project.*
- *To support your school in maximising the benefit of being involved in this project we will offer an after-school briefing for all of your staff lasting half an hour, at the end of our first visit. We hope that this will allow more staff to become engaged in thinking about this area and will provide the starting point for the participating teachers to share aspects of the project which we hope will continue on a regular basis throughout the year.*

Appendix 2: Example research proposal for live 15 minute pre-teaching

What will the teacher say and do?	What do we anticipate the children might say and do?
<p>Sentence starter on the board 'I know that...'</p> <ul style="list-style-type: none"> • Today we are here to see if we can notice things when we are adding. Later in our maths session you are going to help me help others notice things. • Let's check to see how many pieces of fruit there are in the basket. Count the pieces of fruit out 1,2,3... • What addition can we write to show what we did? Record on the whiteboard • That's warmed our brains up! Now we are going to think about numbers we add together to make 10. Give each child a set of cards from 1 to 9 including two fives • Find two numbers from your cards that you know add together to make 10. • Can you show me what this looks like choosing one of the resources? • Tell me what you've done starting with 'I know that...' Record full addition on whiteboard • Are there any others that you know? • What goes with 9 to make 10? Write the addition for any they haven't got on the whiteboard so that there is a list of bonds for 10 • We know these. Let's see if we can use them? Write the addition $5+8+5$ on the whiteboard • Is there a pair of numbers that make 10 here? • Can you show me how this helps with the Numicon? • What have we got now? • What is $10 + 8$? Show $10 + 8$ using arrow cards • Let's look at another addition. Write $9+6+1$ on the whiteboard • What would you do first? Why? Prompt referring to pairs on whiteboard if necessary. Use Numicon and arrow cards again if needed. • How do you know it's 16? • Let's look at another addition $7 + 9 + 1$. • What do you notice that's the same? What do you notice that's different? • How can we make this easy to do? Can you explain how you know? • Let's look at one last calculation. Write $5 + 8 + 2$ • What would you do first? Why? Prompt referring to pairs on whiteboard if necessary. Use Numicon and arrow cards again if needed. • How do you know it's 15? • Can you be ready to notice things in the class today, using what you know about how to make the number ten? You will be able to help some of the others notice things. 	<p>You can't write lots of additions.</p> <p>Anticipated that the most likely pair they will know is five and five, then nine and one, then eight and two. Chance that they might struggle to illustrate or explain using resources. They may struggle to explain what they know. Say: I know all of my pairs that make 10.</p> <p>Using the anticipated most likely bond they will know, $5 + 5 = 10$</p> <p>Not see the five add five contained within this addition. Might need to use the Numicon to help them see it.</p> <p>Not recognise that they know $10 + 8$ so may need to model this using the arrow cards Using the second most likely bond for ten that they will know. Not notice $9 + 1$ and count on their fingers $9+6$ Not know $10 + 6$ Shout the answer – it's 16 Shrug and say I don't know. Say: All odd numbers.....</p> <p>Hardest bond in the session so may not see $8 + 2 = 10$ so might need to model with Numicon.</p>

Appendix 3: Plan for the live pre-teaching for cycle 4

What will the teacher say and do?	What do we anticipate the children might say and do?
<ol style="list-style-type: none"> 1. Give children two cards $6 + 2$ and $3 + 3$. On the table are cards with $7 + 1$, $4 + 2$, $8 + 1$, $6 + 1$. 2. Ask: can you together find a card that is equivalent to/has the same value as each of your cards? 3. Let's look at why $6 + 2$ and $7 + 1$ are equal. Model $6 + 2$ with counters in a line, a gap between the six and the two. 4. Ask: how can we show this is the same as 7 add 1. Expect a child to move one counter across. 5. Record $6 + 2 = 7 + 1$ and say 'So we can say that six add two equals seven add one'. Write the word equals on a card. 6. Use a talking tin and ask the children to repeat in unison. Play back and listen to it together. 7. Say: We can also say 6 add 2 is the same as 7 add 1. Write the words 'is the same as' on a card. 8. Use a talking tin and ask the children to repeat in unison. Play back and listen to it together. 9. Say: We can also say six add two is equivalent to seven add one. Write the words 'is equivalent to' on a card. 10. Use a talking tin and ask the children to repeat in unison. Play back and listen to it together. 11. Point to the other two cards ($3+3$ and $4+2$) and say: We can say the same about these two calculations. Can you show this by writing a number sentence using the two cards and the equals sign? Write up $3 + 3 = 4 + 2$ 12. Give each child one of the cards with the words and ask them to read $3 + 3 = 4 + 2$ using the words they have been given. (Decide if talking tins are needed here). 13. Write $5 \times 4 = 10$ and 2 for all the children to see and say: The ones we just looked at have two additions, this one has two multiplications. Let's look at why these are also equal. 14. Say: We'll start with this side (point at 5×4) - this says five four times (draw a box around $\times 4$). Ask the children to repeat this. 15. Say: Let's see what this looks like with these strips of five dots. We have five one time, two times, three times, four times, (model with strips of dots). 16. Now we're going to look at this side (point at 10×2). This is ten two times. Ask the children to repeat this. 17. Ask: how can we show that five four times (point at dots for five four times) is the same as ten two times? 18. Say: Let's all read the statement using the different language in turn, starting with 'equals'. Use talking tin and the different language cards. 19. We will be using these words in the lesson. Where shall we put them so that you can use them in the lesson? 	<ol style="list-style-type: none"> 2: <ul style="list-style-type: none"> • find them easily • doesn't match any of them • don't understand the language • looking for an answer • match $3+3$ to $6+2$ and $6+2$ to $8+1$ • writes the answer 4. nobody moves one counter, they make a new set with other counters or put all counters together and then make $7+1$ 5. Might question if this is correct or look puzzled by it 6. children might comment on their own voices – could be a distraction 11. $3 + 3 = 6$ and $4 + 2 = 6$ or $3 + 3 = 6 = 4 + 2$ Children might want to model with counters to check and then count in ones 12. might not speak/know how to say the word 13. children might be confused by multiplication 17. <ul style="list-style-type: none"> • might ask for strips of 10 dots • might say both equal 20 but not be able to show the connection with the dots • might count to see both answers

Appendix 3: Plan for the live class lesson for cycle 4

Assigning competence – what will the teacher say and do?	Assigning competence – what do we anticipate the children might say and do?
<ol style="list-style-type: none"> 1. Write $5 \times 4 = 10 \times 2$ on the board. 2. Ask: Can you agree with your partner how you could read this and show me when you are ready by... 3. Listen for children using appropriate language, especially the pre-teach children. Choose these children to share how they are reading it. 4. Ask the whole class to repeat each of the chosen ways of reading. 5. Say: We have read this but do you think that this is true? (give children time to think for a moment on their own) say: thumbs up for true and thumbs down for not true. Say: Tell your partner whether you think it is true and why OR Tell your partner why you think it's true (depending on the thumbs) 6. Ask: Can you and your partner show why they are the same or are not the same? You can use the strips of dots. Be ready to convince the rest of the class. 7. Choose and prime children to share and explain including pre-teach children. (use visualiser) 8. Ask: Has anyone changed their mind? Ask: What or who has helped you to prove it's true? (Mention pre teach children's name to reinforce their contribution) <p>IF TIME</p> <ol style="list-style-type: none"> 9. Ask: Can you and your partner make up another number sentence with two multiplications in it? And another? 10. How did you decide on the multiplications? 	<ol style="list-style-type: none"> 2. <ul style="list-style-type: none"> • Pre-teach children correct their partners • Pre-teach children speak first/speak with confidence • Pre-teach children look at the language displayed • Pre-teach children use the language displayed 4. Whole class repeats 5. Pre-teach children talk to their partners and may say 'it's true because...' 6. Pre-teach children use the dots confidently, taking the lead with their partner 7. At the visualiser: <ul style="list-style-type: none"> • Pre-teach child moves dots and explains • Pre-teach child explains and partner moves strips of dots 8. Children identify something the pre-teach children did or said

Appendix 4: Case studies

Case Study: St Margaret's C of E (VA) Junior School - Y6 teacher Charlotte Hewitt

At the beginning of the project, I described the child in the following way: C is a very uncertain girl. She has a great potential to excel in mathematics but lacks the self-belief and self-confidence to participate in class or group discussions unless she is 100% certain that her answer is correct. If she is corrected, she will not argue her case but simply accepts she is wrong (even if she is not). She will refuse to challenge herself in class and will always stay on the easiest task, even if she is completing it well, to ensure she will never get an answer wrong. This is unfortunately what she views a good mathematician to be, someone who gets all answers correct.

My vision for C was that she would develop a greater level of confidence in herself and begin to understand that mathematics is not about always getting the answer right but about challenging yourself and growing each lesson. By the end of the project, I wanted C to accept that at times you can get answers wrong and learn just as much from making mistakes and discussing ideas as you can from getting things right.

C is significantly different to how she was at the beginning of the year. She participates a great deal more in whole class discussion and is less self-conscious about getting an answer wrong, though this is still an area we are developing. C is very confident to discuss her ideas in smaller groups and will defend her ideas if other children question them which is a huge step from the beginning of the year when she would simply give in and feel downhearted about herself. In her work, C is willing to take a lot more risks; not only will she happily try harder levels of mathematics but she will actively inform me that she is ready to move on and desires a bigger challenge through the lesson. When she does still struggle, she no longer gives up at the first hurdle. She has developed the confidence to accept that she is a very capable mathematician so if an answer is incorrect, she accepts this is not a reflection of her own ability.

During one lesson observation, I assigned competence to C by asking her to teach other children who found the concept difficult. She very quickly took the lead in her group and was supporting the others in the exact way I had supported her in the pre-teaching. She wasn't telling them the answers rather supporting them by letting them do some work then discussing the methods they used and showing how she would have done it. This was incredible for C as previously she never would have corrected another child let alone taught them. At the end of the session I spoke to C and she explained, "That was well fun!" This was one of the first times C had shown genuine excitement during a maths session.

During SATs week C was visibly nervous for the maths test; she hasn't always performed well in tests and previously her body language during tests had been very negative with slumped shoulders and often her head down. By the end of the maths papers she had a huge smile on her face and when I asked her how it went, she commented, "That was actually quite fun!" This shows a dramatic difference; she felt that she could tackle any questions that came up and had a much greater belief in her own ability.

During another observation, the pre-teach children were told to sit with a group of perceived high-ability, high-status children. C did this with no problems and instantly got involved in the maths task with no negative beliefs about her own ability or right to be on that table. When one of the high-status children was stuck on a problem, I arranged it so that the pre-teach child could work with the perceived high-status child to help them. She did this straight away and her body language when being asked to help this child was incredible; she straightened up and immediately seemed to have a greater belief in herself.

The biggest difference to the child was not only going over the misconceptions in the pre-teach so they had a very strong understanding and sense that they knew what was going on in the full lesson but the competence assigned to them afterwards. This seemed to really affect the way they viewed themselves in the lesson and in the class as they had a role and there was a level of trust from the teacher that they hadn't previously experienced.

C achieved a scaled score of 100+ on the end of KS2 maths papers

Case Study: Woodlands Park Primary School – Y5 teacher Jon Merrison

At the beginning of the project, I described D as an enthusiastic participant initially in lessons but who loses confidence mid-flow; her perception of herself is that she gets muddled and is unsure of her own ideas and she believes others are better at maths.

My vision for D was that she would know when she had something relevant to share and would do so with confidence.

D is far clearer and more confident in her explanations now. She has far more influence over her partners and more of her time is spent learning. Early success with verbalisation in front of the pre-teach group fed into success in the main lesson. This developed over time; it started with explicit rehearsal and this has become less and less important.

She is extremely enthusiastic about the pre-teach sessions, always checking whether a session is happening and badgering me to make them up if we had missed one for any reason. When videoed at the end of the project she spoke about having greater confidence because of the language inputs, her own ability to explain successfully to others and her monitoring role.

D has made huge leaps forward in maths understanding; in her assessment at the end of the year she achieved a standardised score of 107.

The biggest difference seems to have been having access to regular pre-teach sessions. These gave D privileged time with her class teacher, with a focus on language and images, and gave her involvement in the planning process and monitoring of others meaning there were no surprises in the main lesson.

Case Study: Ashleigh C of E (VC) Primary School – Y3 teacher Sarah Parris

At the beginning of the project, I described A as very quiet and unassuming, often saying “I can’t do it.” He became tearful when maths become challenging.

My vision for A was to raise his mathematical confidence and aim towards a greater depth of understanding.

There has been a huge increase in A’s confidence. He is now prepared to face a challenge and explains concepts to others. He takes an active role for the whole of maths lessons. Teaching assistants have commented on how he has changed from a ‘silent’ member of the class to one who will always share his ideas. He is prepared to make mistakes as part of the learning process.

A’s parent has made positive comments both to A and about A, particularly with regard to his confidence. A said: “I have never been this good at maths before!” His scores in maths tests have increased during the year going from 8/20 in the autumn term to 13/20 in the spring term and 20/20 in the summer term.

The biggest difference seems to have been giving A the additional time in the pre-teach group; he said: “Hearing it more than once helps me.” As a result he now believes in himself in mathematics.

Case Study: Two Moors Primary School – Y3 teacher Sam Butler

At the beginning of the project, I described C as follows:

- Low self-confidence
- Shouts out random answers without giving any thought or attempting to use a strategy to work out an answer.
- Believes he is 'not good' at maths
- Unable to link his ideas and thoughts between different areas of maths.

My vision for C was for him:

- To think before he speaks to the class or answers within a group.
- To use the strategies and knowledge that he has to work out answers rather than guessing.
- To believe in himself and to acknowledge his own areas of strength.
- To view himself as an equal member of the class and to value his own opinions.

There have been a number of changes which include:

- C gives himself clear thinking time and would rather take longer to get to the right answer than to be quick with the wrong answer. As a result of this he can give more relevant and detailed explanations to the class as he has been through the processes in his head. He therefore has a more influential role in the class as others feel he has thought about his answer rather than guessed. It was noticed in an observation that he was someone who tried to use strategies and apply his knowledge. He was chosen for a pupil interview when OFSTED visited and came across well.
- His self-confidence has improved and he believes that he is able to work through a problem. He does not think he is the best mathematician but has confidence that he can solve problems rather than masking it with 'false confidence'. During a lesson C was working with a high status child and they turned to him for support as he had been active and influential in the whole class input. The other pupil acknowledged that C had been helping her and that she would have been 'stuck' without him. I asked him how that made him feel and he replied "I have never felt like it, I can't believe X needed me in maths!"
- Across all subjects C has a new confidence to answer fully rather than guess. He is confident with good reason rather than just saying he is a 'genius'. C's parents have noticed a significant difference in his engagement at home and his ability to think before speaking. They have been very supportive and reminded him to 'think and then speak' when answering any question. C has made progress from being about a term and a half behind at the start of the year to being very close to age-related at the end of the year.

The biggest difference for C has been:

- Having the extra time to 'struggle' with mathematical ideas before entering the classroom and whole class discussions.
- Having the confidence to slow down and think before answering, realising that speed is not always a good thing.
- Believing that his status has improved and that he is now regarded as someone who can contribute to the class. This has been achieved through assigning competence and allowing other pupils to assign competence.

Case Study: Two Moors Primary School – Y3 teacher Danielle Davison

At the beginning of the project, I described N as nervous, worrying about giving the wrong answer, is dependent on others and passive in group situations. She also finds it difficult to articulate her answers and explain her strategies.

My vision for N was that she would have confidence in her ability and ideas, working independently and being able to articulate her thinking.

N is now happy to work independently in lessons. At the start of the year, N would look around to check with others about what she needed to do. She now explains to others about what to do. In lessons, she often puts her hand up to share her ideas and explain her answers. When given tasks that require N to work with peers, N is an active and influential member of her group. She listens to her peers, but if she disagrees with them she will explain why until she has convinced them of her reasoning.

When N was asked about how the pre-teaching sessions helped her she said: "It makes me feel good because I am helping the teacher because then they don't have to explain it to everyone because I can explain it to people too". N was able to give an example of how she had helped someone, a child who typically holds high status within the class. N said: "I tried to show her something but she didn't believe me. So then I explained it to her and she believed me and changed her mind. It made me feel good because I helped someone." In the lesson where this happened, N first tried to convince the other child with a verbal explanation. When the other child still did not accept this, N used resources to give an example. When an adult next went over to N, N said "X believes me now!" The other child then told the whole class how N had helped them and what N had taught her.

During a lesson on fractions in the summer term, the class were given a pictorial representation and needed to explain what fractions the picture showed. This echoed a lesson from an earlier pre-teach lesson in the autumn term. Another child, who typically holds higher status, immediately turned to N when they were given time to talk in groups about what they thought the picture showed. N began pointing at the picture and talking whilst the other listened.

N was selected for pupil interviews by senior management to discuss maths. The comment from the member of staff afterwards was that "I was impressed by N. She spoke very well. I never knew she was so articulate."

The biggest change has come from N knowing something in a lesson that others don't such as how to use resources. It means her partner or group have to listen to her. Trying ideas and tasks out before the main lesson gives her confidence to explain to others in the lesson, as she knows she is definitely correct. Her confidence has grown over the year as she developed more belief in her ability. This became more visible over time, even in lessons that don't follow a pre-teach.

Case Study: Whipton Barton Junior School – Y3 teacher Trudi Steer

At the beginning of the project, I described G as very insecure about her maths learning. She would rarely put her hand up whilst on the carpet and would quite often let others take the lead when working in small groups. She appeared to not enjoy her maths an awful lot and would do her best to avoid any attention or communication from myself during maths lessons.

My vision for G was I wanted her to enjoy her maths, but for this to happen, I had to ensure that she was engaged in her learning. I wanted her to offer more ideas on the carpet, whether these ideas were right or wrong. As well as this, I wanted the child to realise that she was *good* at maths and had the potential to be even better at maths. Before the pre-teaching, she had an 'I'm not good at maths' attitude, which I hoped to reverse by the end of the project.

There has been a considerable improvement in G's willingness and openness to talk about her maths. In almost every maths lesson, she will have her hand up on the carpet and will even challenge other people's ideas. She adores her maths learning and will now often say 'I love maths Mrs Steer' or become visibly excited when our maths lessons are about to start. As well as this, I have seen her become more flexible with who she sits next to in maths lessons and will not just resort to her comfort zone. Mum has also commented a few times on how much she is enjoying her learning now and how she talks about our 'maths group'.

This confidence has spread to other aspects of her learning. She is so much more vocal on the carpet in all lessons and she has more of a presence in the classroom.

The biggest difference has been that by having a 'sneak peek' of the maths we are going to be looking at in the following lesson, it gives G some thinking time before others 'take over' and reach an answer more quickly. Within the pre-teaching I would often show them the slides and we'd discuss the sort of questions I might be asking. This gave us time as a group to discuss it, and also time for the individuals to think about the answer at their own pace. I think that she has developed a higher 'status' within the classroom, especially whilst doing carpet work. Many would often assume that she didn't know the answer, but as our pre-teaching sessions continued, she started to surprise people with her confidence and accuracy. I also think that the pre-teaching sessions made her (and the other children) feel special, as they knew that it was their time with me and that they were the 'lucky ones'. As well as this, our pre-teaching sessions were quite relaxed and we would often laugh a lot. This then put the positivity back into maths for her and she really started to enjoy herself a lot more.

Case Study: Whipton Barton Junior School – Y3 teacher Gareth Morris

At the beginning of the project, I described B as a quiet boy, who lacks confidence in his abilities as a mathematician who can disengage before a session has started as he feels he will fail. Because of this, he does not like to share and join in with whole class and group inputs.

My vision for B was for him to gain confidence in his ability in maths, as often his head would drop before a lesson. I also wanted to see him engage more often in whole class and small group discussions, as he was very quiet and passive.

B is now much more vocal and articulate in lessons. When engaged in carpet work, he is keen to share his ideas and enjoys having the respect his peers give him. He carefully considers everything he says before speaking and his maths vocabulary has improved. He has become a lot more confident when engaging with his peers and is happy to support them in their learning. It is apparent now that he enjoys our maths lessons more, especially if he has engaged in the pre-teach session before hand. He has made real progress in his maths and his mum has said that he is a lot happier around his maths and that she has noticed a big change in his attitude towards it. This has been apparent through their daily discussions and his homework.

I think allowing B to have access to the concepts and ideas taught in the lesson beforehand has been particularly empowering. He is able to sound try his thoughts and ideas and ask questions in a small group with no fear of being embarrassed in front of his peers. In addition to this, I believe that the act of the teacher giving up time to spend with him and his peers has made him feel special and this has in turn had a knock on effect on his confidence, which has led to him saying that he believes in himself more. As well as this, having other adults within the school aware of and engaged in the project has meant that his progress and growth throughout the sessions has been validated throughout the school. I also believe that having good home links is key and I maintained dialogue with his parents to ensure they were aware of the progress he was making.

Case Study: Dartington Primary School – Y6 teacher Maz Foucher

At the beginning of the project, I described W as very quiet, all her written work is beautifully presented but this masks a lot of gaps in her understanding because she is a very convincing copier; working in groups a lot she often has done more work than the rest of her group but because she can write fast she writes down other people's ideas as well as her own. From looking at her books she looks like she is 'on track' but when asked to do any sort of assessment task she comes unstuck. She lacks confidence and clings to other children.

My vision for W was that I really wanted her to grow in confidence and to be able to articulate her thinking more, using more mathematical vocabulary. She found it hard to express herself verbally and used a 'baby voice' and said "Ummm" a lot every time she was asked a question she was unsure about. This was what she did every time she found herself in a situation in which she lacked confidence in herself. Her answers to the questions were vague and very basic. I also wanted her to recognise areas of maths that she finds easier or harder and to be able to see that not knowing a few elements does not mean she is 'bad' at maths.

W now appears to be able to focus on forming an answer and speaks much more confidently about her maths. She can answer questions in lessons (although she still struggles with this sometimes in a whole class situation) and is much more confident when working alongside other children, directing the tasks rather than simply parroting other children's ideas and rushing to write them all down in her book. She is now able to explain what she finds hard within her maths and give herself a rating as to how hard she finds it; she no longer feels that she is a bad mathematician, understanding that there are simply some aspects that she hasn't learnt thoroughly yet. In her report W's mother wrote: "W has succeeded in understanding maths better."

The biggest difference has been that, given the opportunity to discuss her maths in a non-judgemental, safe environment, she now understands that it is okay to say when you don't understand in mathematics and realises that there are some areas of maths that she is actually very good at. The pre-teach sessions have been a chance for W to have a heads up on what the lesson is going to be about, so that she has a practice run first, rather than the constant anxiety of not knowing what is ahead.

Through the improvement in her confidence, W put herself forward to play Nick Bottom in our Midsummer Night's Dream performance. She played this role brilliantly – she is like a different child from the quiet, shy, vague, confused girl we started the project with in October.

Case Study: Great Torrington Bluecoat C of E Primary School – Y2 teacher Naomi Pluckrose

At the beginning of the project, I described A as a quieter member of the class who lacks confidence. A is disengaged, often looking out of window or around the classroom rather than at the person who is speaking. He rarely joins in during whole class sessions unless asked. When he does, he finds it difficult to find the word he wants to use to explain his thinking. A lacks 'stickability' and gives up easily. It can be difficult to get him to 'have a go' without any tears.

My vision for A is that by the end of the year I would like A to engage for a part (even if it's brief) of each session and start to share what he knows with a friend and an adult. I want him to enjoy some of his learning in maths and share this with others too. I want A to achieve ARE by the end of the year.

A is now actively participating daily. This is evident through raising his hand to answer questions, working with a partner to solve calculations and problems and a willingness to talk to other children and adults about what he is learning. He is using our maths sentence starters to explain his thinking. A is much more confident to share his learning, smiles when he is sharing what he knows and has even carried out some learning at home through the use of 'Mathletics'.

In lessons, A is confident to raise a hand to offer his response to direct questions, speaking in full sentences so that everyone can understand what is being said. During one observation, A was very excited about what he knew, actively wanting to take part during the whole class session. A used the sentence starter "I noticed that..." with confidence to help structure his response.

A will help others when needed without being prompted by an adult. In one observation, A chose a partner to solve some mental addition and subtraction calculations. He verbalised his thinking to the partner, saying how he used his knowledge of tens and ones to help him. This was without being asked.

A now appears more engaged each session, showing good looking and listening and focussing more attentively on the person who is speaking or the image being shown. He now actively seeks a partner to share ideas on the carpet. The confidence in his own ability has really changed over the course of the year and others are now accepting help and sometimes even relying on A for support.

When A was asked about how he felt when asked to share something with the whole class, he replied "Um, pretty happy". When asked why, he answered "Because I like telling everyone stuff about maths".

Case Study: The Erme Primary School – Y1/2 teacher Amina Abdellaoui

At the beginning of the project, I described E as a very quiet little girl, very sensitive towards others. She came out of EYFS as exceeding and came out of Year 1 as secure within maths. She is a very able reader. She does not often have the confidence to contribute to class discussions within maths lessons. She will quite often worry about making a mistake or not understanding the concept being taught. She will rarely ask for help.

My vision for E was for her to increase her confidence and competence, develop her problem-solving skills and be willing to take risks.

E's confidence has greatly increased in many areas. During a main lesson E could identify that her partner did not understand a particular concept. She had the confidence to teach and explain it in a different way to the way she had been taught in the pre-teach.

E often does extra independent maths at home in her notebook with colourings and drawings around it. She had said that she used to look forward to the days when she did not have to do maths but now she looks forward to maths every day. In the interview she said that she did find maths tricky and now enjoys teaching it to her peers. She will ask on a regular basis when she can next teach the whole class a concept that she has been pre-taught.

E regularly contributes to all class discussions, including maths, She is willing to call out in whole class discussions when prompted; her confidence in her own ability is greatly increased. Other children will often ask her for help and she is now volunteering to help others within maths even when she has not been pre-taught.

The biggest difference has been E choosing her own role in the main lesson and therefore assigning her own competence at a pace that suits her. The change in the other children's perceptions of her mathematical ability has greatly increased her confidence; she has moved from low-status to high-status. She has been able to use her strengths in reading to develop her confidence within maths through reading the problem to be resolved or reading a definition of a mathematical term.

Case Study: The Erme Primary School – Y6 teacher Kate Eames

At the beginning of the project, I described R as an 11 year old girl, who had been on the SEND register since she was in Y2, and was thought to have dyslexic type difficulties. She had made very little progress through key stage 2, and had often been reluctant to contribute or even participate in maths lessons.

In Y6 we started running a pre-teach group every day, called the 'Fabulous Five' – a name chosen by the children. Y6 at The Erme is taught by two teachers, and both teachers ran these groups before every maths lesson. R was originally reluctant to be in the group. This was because the 'clever' children were not in the group and so she had decided that it was not 'cool'. In addition to this, the rest of the class were given an independent maths activity - sometimes a game to play - whilst the group ran, and R thought she should be allowed to do this activity. Both teachers asked her to join the group every time, and eventually she began to join in and contribute.

After a while, R's attitude changed, as she saw that the information given to the group enabled them all to have a higher status in the whole class lesson, and far from seeming less able, the participants in fact were able to engage in maths that other children were unsure of. R particularly enjoyed the chance to spend more time using concrete apparatus in the small group. She had not engaged in this in previous year groups because she identified that 'they use it in the infants', but now she made herself responsible for collecting and distributing the equipment in lessons. Drawn images were not so easy for her; she found it difficult to create her own, but could work with and reproduce ones created within the group.

Notable changes within the whole class lesson included R's response to teacher intervention. Previously she had put her head down on the table if an adult tried to guide her through maths learning, but now she engages with the teacher prompts, enjoying being involved and explaining things back to adults and her partners.

One of the regular activities of the pre-teach group was to make notes on the learning so the children could refer to these if they needed, hopefully helping them to feel more confident in the main lesson. R initially referred to the notes a lot, but by the spring term was able to retain a lot of the information and use it in the main lesson. Whilst previously R would always check with the adult in the class before recording an answer or other response, this need for reassurance has reduced and her independence increased.

Another thing we tried with the group was to allow them to choose their own roles in the main lesson, so that we could assign competence to them without them sitting worrying about what contribution we might ask of them. R tended to always choose the same type of role – usually explaining and distributing equipment – keeping real discussions to her small talk trio. Then one lesson she volunteered to draw a bar model on the board to explain an aspect of learning about percentages (how 100% was made up of 20% + 80% etc.). She drew the bar model, but couldn't think what to write in it so she sat down. The empty bar model was left on the board and we moved on in the lesson. Then suddenly she stood up and went over and completed the labelling, all correctly, in front of the whole class. This was a major shift for R.

Now R is much more confident about her maths and taking risks within the daily lesson. She is predicted to have reached age-related expectations in her Y6 test, and she is no longer on the SEND register. This means she will transfer to secondary school and join middle sets, which would not have happened had she not moved on so much from the beginning of the academic year.

Appendix 5: Data

The impact has been extraordinary. The three children who have made the most progress this year have been the three focus children who have experienced more pre-teaching than others – Y6 teacher

For the 17 schools involved in the project, there was an average increase in end of KS2 results of 10.5 percentage points in 2017 compared with 2016. Two of the schools were forced to reduce their involvement during the year due to different circumstances; when they were removed from the figures, the remaining schools saw an average increase of 14.8 percentage points.

End of key stage data was available for only a small number of individual children as most of the children involved were not in Y2 or Y6. Except in one school, at the beginning of the year, the children selected were children who were not on track to achieve expected at the end of the year. For those that were in Y2 and Y6 the data is as follows:

Y2 data: 18 children, 14 achieved expected (78%)			
School	Number of focus children	Test Scaled Score Range	Reported Teacher Assessment
1	3	98 to 107	Two achieved expected One achieved working towards
2	6	99 to 109	Six achieved expected
3	3	96 to 100	Two achieved expected One achieved working towards
4	3	98 to 98	Three achieved expected
5	3	88 - 97	One achieved expected Two achieved working towards

Y6 data: 15 children, 13 achieved expected (87%)			
School	Number of focus children	Test Scaled Score Range	Reported Assessment
1	3	100 to 107	Three achieved expected
2	3	105 to 114	Three achieved expected
3	3	98 to 103	Two achieved expected
4	3	96 to 103	Two achieved expected
5	3	101 - 104	Three achieved expected

The three children began the year with little confidence in maths and very little confidence in themselves. Their first assessment in December showed them scoring 33%, 28% and 34% respectively. The children all had very little confidence in themselves and would never offer their hands up. The summer SATs showed the children being incredibly confident in their ability – one child is quoted as saying, “I love SATs” and another saying as the week ended, “Actually that was really fun”. The children’s attitude in their own ability had completely changed and they felt that they could answer the questions and had a very reasonable chance of passing. There were smiles on their faces the whole week and at no point in any of the tests did they give up or feel negative towards their own ability.

When asked how the pre teaching had helped them, one child said, “It meant that I felt confident in the things I used to find hard so I didn’t have to worry when a question came up.” Another said, “I just knew I’d be able to do it because I can always do it in our groups.” The final child said, “I felt more confident so I knew that I could have a go.” All the children agreed that the group had helped them with their knowledge and they all agreed it had helped with their confidence. – Y6 teacher

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