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|-------------|------------------------|
| Date        | March 2017             |
| Key stages  | KS2                    |
| School type | LA maintained, primary |
| Themes      | Mathematics            |

# Increasing attainment and fostering a positive approach towards mathematics for White British pupils

## Howe Dell Primary School

### Context

Howe Dell Primary School is a larger than average school located in the Welwyn Hatfield district of Hertfordshire. The school was rated as 'good' by Ofsted in 2013.

### The focus

On Friday 18<sup>th</sup> September 2015, the Herts for Learning maths team hosted a national conference with Jo Boaler, Professor of Mathematics at Stanford University, as the key note speaker. Many Hertfordshire teachers attended the conference to find out more about developing mathematical mindsets and were inspired to continue improving opportunities in mathematics for their pupils through an action research project. The purpose of the project was to explore some of the themes covered by Jo Boaler and research different ways of developing mathematical mindsets. *This case study has been written by Pete Mason, Deputy Headteacher at Howe Dell School.*

The school has evolved and expanded into a two-form-entry primary school which now has over 450 children from Nursery up to Year 6 (there is also a Day Care on site), relocating to its new purpose built eco-site in 2007. It is set close to the University of Hertfordshire in amongst a mixed build residential area, with affordable social housing, on the Hatfield Business Park.

Upon intake, attainment is low with a profile of children that means EYFS is below national averages. Progress is made in Key Stage 1 but outcomes are still below national average. However, by the end of Key Stage 2, children out-perform national averages and there are now strong improving trends over a number of years. Over 50% of children have EAL, however, they generally do very well in terms of attainment and exceptionally well in terms of progress. They usually exceed outcomes for progress relative to the overall cohort, which also tends to be high over time.

From RAISEOnline and the Ofsted Dashboard, the current category of vulnerable children under-performing are White British children. Therefore, efforts have been made to boost and improve the self-esteem, confidence and aspirations in order to improve both progress and attainment within this group. Almost 50% of children in KS1 and KS2 fall into this category, with the highest numbers in Year 4, hence they became part of the focus group.

## Description of my approach

Six children were selected from a Year 4 class to form the focus group; they were a mixture of boys and girls but all from the White British category:

Child 1: White British (WB), Traveller

Child 2: WB, Free School Meals (FSM), Summer Born (SB)

Child 3: WB, FSM

Child 4: WB, FSM

Child 5: WB, SB

Child 6: WB, SB

Their abilities ranged but not significantly and all had been noted as relatively static in terms of visible progress in the first half of the year. The group would meet once-a-week with me to undertake problem solving activities; this was in addition to their normal maths lessons with their class teacher and teaching assistant. Assessment materials produced by HfL (Phase B) were used as the basis and stimulus for each session with the emphasis being on discussion, trial and error and recording in an attempt to engender a love and enjoyment of maths, to break down any perceived barriers and to generally develop a 'Mathematical Mindset' of inquisitiveness and resilience.

A different HfL assessment task was used as the basis for each week (some extended over two):

### Arithmetic laws (multiplication)

- Pupils will investigate different ways to make 24 with multiples of 2, 4, 6 and 8.
- Pupils will develop their mental fluency and ability to apply arithmetic rules by finding multiple solutions.
- Pupils will have to use and apply their times table and arithmetic rules knowledge to solve the problem.

### Number and place value

- Pupils will write numbers as digits that are read to them identify mystery numbers and sort generated numbers.
- Pupils will draw upon their understanding of place value and other knowledge about the properties of number to identify a mystery number.
- Pupils will engage in a sequence of work which will require them to make connections, sort information and justify reasoning.

### Written calculation fluency

- Pupils will be assessed on how their mental fluency supports their knowledge and understanding of formal written methods.
- Pupils will demonstrate their understanding of calculations set out in the formal written method for addition and subtraction.
- Pupils will have to use and apply their place value knowledge to solve the problem.

The approach centred on the concrete-pictorial-abstract (CPA) elements. For instance, in the first session children discussed the challenge ahead of them before being given Lego bricks to use in order to make 24. This then progressed on to representing their thinking diagrammatically before listing the different ways in which 24 could be represented using digits and the multiplication sign. This concept proceeded in the other sessions with the use of number cards and over-sized tiled sheets on which to place them.

Throughout, children were encouraged to discuss their thinking and reasoning and adopt trial and error methods if a methodical method wasn't readily evident. The intention being to build up their inquisitive nature in relation to

maths but also to try and develop resilience and persistence. Usually there was more than one solution to find, thus trying to move away from the idea of right and wrong and instead encouraging exploration.

Children were generally given a free choice as to whether to work individually, with a partner or with a group. Each time they were asked why they adopted that approach and if they had thought about any other ways to solve it. This preferred work practice has since been adopted as a key aspect of pupil voice led evaluation for maths across the school.

Initially the children were a little reluctant. After all this was a new face in the room in front of them but soon they responded to the ethos of the sessions and were asking when the next session was going to be. A no-hands-up approach was adopted in an attempt to stimulate dialogue; this again took a little time to be fully adopted by the group but worked well. One member of the group was particularly quiet and it was therefore important to work one-to-one on occasion or deliberately pair them up in order to ensure what little confidence they had with maths was not knocked any further but instead was nurtured. Quickly, children began to relish the challenges (“That was hard but in a good way”) and would respond positively to being asked to find an alternative solution. A great sense of achievement was felt when a challenge was overcome often after different strategies and approaches had been discussed by the group.

## Widening the approach

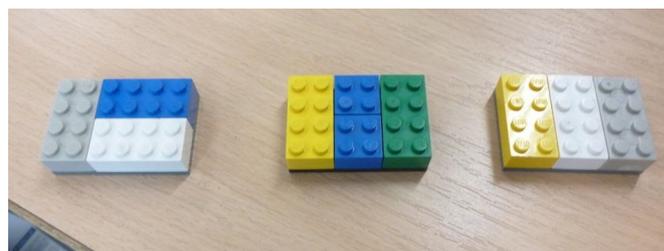
Each session was written up afterwards (some pupil examples can be seen on page 4) and discussed with the class teacher together with the contributions the children had made and the progress they appeared to have made with their learning. Subsequently, the class teacher has adopted the approach in class and has been observed delivering a “Maths Mastery” lesson in the presence of the Head Teacher and the HIP, adopting similar principles to those used in the tasks .

Resources used by the project and developed by HfL have been made available to all class teachers who have been positively encouraged to adopt them and apply them in lessons; this implementation has been successfully observed when looking at plans, which show evidence of tasks being used in lessons. Teachers have also approached me to discuss the ways in which they could incorporate the documents into lesson situations. Whilst referred to as HfL assessment documents, they have been used more as a tool to stimulate discussion in maths groups and to offer low-floor-high-ceiling activities to the children, thus again encouraging a Growth Mindset with regards to maths.

Recently an additional maths group has been established for ‘cusp’ girls in Year 5 applying similar principles. However, this group, whilst run by myself, has the assistance of three more able girls from Year 6 who contribute to and help out within the sessions. The Year 6 children are encouraged to discuss possible strategies rather than to ‘help do’. Indeed the most recent session involved an exchange where one of the Year 6 girls asked, “How have you arrived at that answer?” At which point the Year 5 girl began to erase and correct but was interrupted by the Year 6 girl saying, “No, I didn’t say it was wrong. I asked ‘how did you get it?’ – explain it to me.” This perfectly demonstrates the Mathematical Mindsets approach in action.

### Working Mathematically – Lego 24

Session began by asking children to fill their Lego base with any size of block they wanted. Pupils then used the covered bases to explore “What is the same and what is different?”



| HFL Mathematics Assessment Task                                                   |                                                                                   |                                                                                   |                                                                                   | Phase B: Arithmetic Laws |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|--------------------------|
| BRLS                                                                              |                                                                                   |                                                                                   |                                                                                   |                          |
|  |  |  |  | Number sentence          |
| 0                                                                                 | 0                                                                                 | 0                                                                                 | 12                                                                                | <del>6x2=12</del>        |
| 3                                                                                 | 0                                                                                 | 0                                                                                 | 0                                                                                 | 12x2=24                  |
| 0                                                                                 | 0                                                                                 | 0                                                                                 | 0                                                                                 | 3x3=24                   |
| 0                                                                                 | 4                                                                                 | 0                                                                                 | 0                                                                                 | 6x4=24                   |
|                                                                                   |                                                                                   | 0                                                                                 | 0                                                                                 | 4x6=24                   |
|                                                                                   |                                                                                   | 0                                                                                 | 0                                                                                 | <del>2x4=24</del>        |

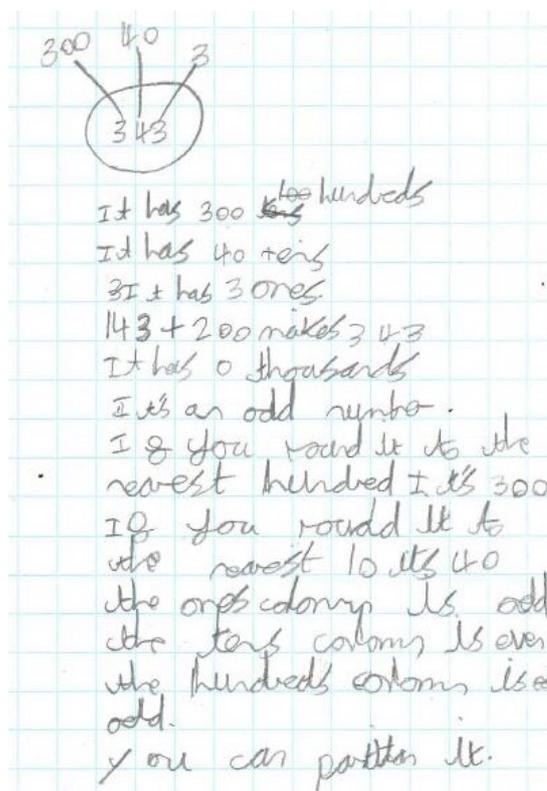
Talks initially centred on children clarifying the technicalities of the task and which equipment they could use. Following that, we introduced the requirements of the first task – to exactly fill the 6x4 board with the 2x4 bricks. We walked through the approach together and discussed possible ways of recording our findings. Children were then given the recording sheets and asked to work systematically to record all of the different solutions.

Children were presented with a recording sheet, tile representations in order to show pictorially (if desired) and a range of Lego.

### Number and Place Value Number Clues

Pupils were given the number 343 and asked to write down as much as they could about it – anything that sprang to mind.

After a while and after having listened to some of the contributions, additional time was given to add more.



## Impact and recommendations

Exit questionnaires completed by the children show an increase in confidence of 0.83, on a sliding scale of 1-5, when comparing their feelings from the beginning to the end of the project, with an identical result in terms of how good the children see themselves at explaining their ideas and answers. There were a range of responses in terms of which of the activities they had encountered they had enjoyed the most, which is quite pleasing and suggests different learning styles being accommodated. When asked to describe a good mathematician, the children responded with someone who “perseveres”, “gives it a go and doesn’t give up”; “is brave and trusts their answers”; who “doesn’t mind making mistakes”; someone who “tries hard and works together”; “makes mistakes and is good at working things out” and “practices”. These clearly demonstrate concepts associated with a Growth Mindset and indicate that the children have learnt and adopted techniques and strategies to help them with their maths.

End of year assessments also suggest a more positive mathematical mindset backed up with strong progression, with the exception perhaps of one child whose confidence in Maths remains less secure:

|         | Y3 Exit Assessment | Autumn Term Y4 Assessment | Summer Term Y4 Assessment |
|---------|--------------------|---------------------------|---------------------------|
| Child 1 | A6                 | B1                        | B4                        |
| Child 2 | B1                 | B1                        | B4                        |
| Child 3 | B2                 | B3                        | B5                        |
| Child 4 | A6                 | B1                        | B2                        |
| Child 5 | B1                 | B2                        | B5                        |
| Child 6 | B1                 | B2                        | B5                        |

Of course, the project incorporated only one session per week, this being in addition to the regular five maths lessons being delivered in the classroom by an excellent class teacher and experienced teaching assistant. Therefore, it would be remiss to assume that any progress and improvements in the approach to maths by these targeted children are as a direct result of work involving the HfL materials. However, progress has been made by all of the children and their approach in the sessions became very much more independent and experimental over time.

The conclusion therefore is that these children can be stimulated by open ended maths challenges and, therefore, encouraged to fulfil their potential. The opportunity to take risks and to explore different options and approaches in small groups with partners or individually has allowed the children to develop. More exposure to low-floor-high-ceiling problem solving should enable a Mathematical Mindset to be developed.

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|--------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Contact                        | Pete Mason, Deputy Headteacher at Howe Dell Primary School                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Reading and website references | <p>School website: <a href="http://www.howedell.herts.sch.uk">www.howedell.herts.sch.uk</a></p> <p>Using Questioning To Stimulate Mathematical Thinking by Jenni Way (NRICH 2473)</p> <p>Understanding John Hattie's Visible Learning Research in The Context Of Carol Dweck's Growth Mindset by Gerry Miller</p> <p>Holywell Primary School and NRICH Action Research Project 2012</p> <p>Children's Perceptions Of, and Attitudes Towards, Their Mathematics Lessons by Alison Borthwick</p> <p><a href="http://www.growthmindsetmaths.com">www.growthmindsetmaths.com</a> Helen Hindle</p> |

If you have an aspect of interesting practice that could be shared or are interested in finding out more about a case study please get in touch by emailing [exchangingexcellence@hertsforlearning.co.uk](mailto:exchangingexcellence@hertsforlearning.co.uk)

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