Unlocking Children's Maths Potential

Background to the whole project:

"Researchers now understand that every child can achieve at the highest levels in maths at school, if they are given the opportunities" (Jo Boaler 2014 p.2)

This action research looks at how to give disadvantaged children the opportunity to learn maths to the highest levels. Boaler suggests that five research results provide details of how to transform learning. This research focusses on:

1. All students can achieve at high levels.
2. Students' ideas about their ability determine their learning pathways and math achievement
3. Mistakes and struggle are extremely important for learning
4. Mathematics should be disassociated from speed
5. Teachers' messages are hugely powerful

How can we support children to understand they can all learn maths?

Context:
This is a smaller-than-average primary school with pupils attending mainly from the local area. The pupils are taught in four classes; Reception and Year 1, Years 1 and 2, Years 3 and 4 and Years 5 and 6. Nearly all pupils are of White British heritage. The proportion of disabled pupils and those with special educational needs supported by school action is average; the proportion supported at school action plus or with a statement of special educational needs is average. The proportion of pupil's eligible for the pupil premium, which provides additional funding for children in the care of the local authority, pupils known to be eligible for free school meals and those from service families, is below average. Currently, the school has no pupils who are in the care of the local authority or any children from service families.

Summary:
It is assumed that talk for maths would enhance children's learning and therefore raise attainment. Through shared dialogue with small groups of children one could argue that skills, concepts and knowledge is enhanced. However, what if talk for maths was taught as a subject in its own right? Would this have a greater impact on children's understanding? Alongside talk, what was the role of listening and responding? Could the children be trained to make a worthwhile contribution to their group and be able to work truly collaboratively? The aims are to explore group thinking and collaborative learning. If collaborative learning is an effective means to support higher order thinking how can this be best achieved? 'Thinking is at the heart of mathematics and therefore should be at the heart of mathematical thinking and learning' (Drury 2015)

Research question:

How best can we use talk for learning to support the target children to make rapid mathematical progress?

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Research approach:
To begin this research it was important to set the ground rules for exploratory talk, in which:
• Everyone listens actively
• People ask questions
• People share relevant information
• Ideas may be challenged
• Reasons are given for challenges
• Contributions build on what has gone before
• Everyone is encouraged to contribute
• Ideas and opinions treated with respect
• There is an atmosphere of trust
• There is a sense of shared purpose
• The group seeks agreement for joint decisions
Mercer (2008)
Bearing this in mind all of the children needed to be explicitly taught how to engage in meaningful debate and the associated listening skills that would be required.

Observations:

Task 1;
A deliberate effort was made to group the children with each group having at least one 'able' mathematician. (Able being identified using teacher assessment and previous summative test results) Where possible the groups would be mixed gender, however this cohort is predominately girls.
The children were given a traffic light activity (Lyn Dawes 2008) ground rules for talk. They would have to decide as a group which of the statements were 'good ideas, not good ideas or not sure.'
Most of the groups were able to identify the good ideas for talk, for example, 'We will make group decisions that we can all agree to.' Following this the children were given an activity to solve using their own talk rules that they had agreed. Then the children needed to self-assess rating their group's performance, rating themselves out of 10.
The groups found it a little more challenging to accurately rate themselves.

Task 2;
Finding given a fraction of a square. http://nrich.maths.org/5061
Before the task the children were reminded of the rules for talk and shown two videos of children working in groups – one where the children were not working collaboratively and another where the children were working more as a group.
The children found it easy to recognise true group work and could also identify where the group was not working well.
Prompt cards were given to each group. Examples of what was written were 'Why do you think that?' 'I would suggest that..'
This activity generated useful talk and encouraged the children to justify their thinking. With the prompt cards in full view the other members of the group were able to insist that explanations were clear and concise. Children were able to physically cut and manipulate the fractions to show proportions of the whole.

Observations con't:

Task 3;
Cheesy Triangles
A fraction based activity finding the proportion of an equilateral triangle that is shaded and subsequent smaller triangles.
Prompt cards were available but although on the table were not used by the group.
Explanations were more concise with little interruption from other group members.

Task 4;
Chess moves http://nrich.maths.org/518
The children were given the task which they each read in silence. Lolly sticks were used to identify which children in the groups were to speak first, second, third etc. This ensured that each child could verbalise their own thoughts, while the expectation on the others was to listen and when their turn to speak, could develop what their peers had already started. I did need to ensure that the children had enough thinking time.
Prompt cards again were available but the group chose not to use them.

Task 5;
The rabbit, hay and the ferret. http://nzmaths.co.nz/resource/lake-crossing-1-0
Children were again asked to the problem in silence. Lolly sticks were used to identify those children who were to speak and those who were expected to listen. Resources were available for the children to use. The children in the target group used no prompt cards but did take it in turns to explain their thinking and ask for help when needed. When a further animal was introduced, which made the task impossible, the children's frustration was evident.

Impact on Learners

- Active listening children were expected to listen. 'Once students have shared their thinking with the class, it's helpful to get others to simply repeat what has been said,' (Private talk, public conversation. Mike Askew)
- Increased confidence when tackling challenging mathematical problems without the fear of getting it wrong. ' It's not impossible, you just have to think harder' (Year 5 girl)
- Learners are more explicit when talking about mathematics using increasingly precise vocabulary.
- Children have developed metacognitive skills enabling them to think through a problem or the way they approach a learning task, selecting appropriate strategies, and making decisions about how to resolve the problem or successfully complete a task.
- The children think about their own thinking processes, taking time to think about and learn from mistakes without the fear of being wrong.

Impact on researchers and the wider school community

The impact has been to raise the profile of mathematics to the extent that our link governor is keen to promote the STEM subjects throughout the school.

The 'Learning Pit' (James Nottingham) has been an integral part of teaching and more importantly learning within the years 5 and 6 and in due course will be cascaded down to the other classes. We did not intend to change a culture of learning, however, this appears to be happening. Children are more comfortable taking risks with their thinking evidenced by responses for example, 'I think the answer is… because.' At one point the children were keen to get out of the learning pit but now see it as a worthwhile place to be, with no shame attached to being in the pit. Through staff meetings a growth mind set is achieved by cascading knowledge and experience from real life teaching and learning. 'Motivation is the most important factor in determining whether you succeed in the long run. What I mean by motivation is not only the desire to achieve, but also the love of learning, the love of challenge, and the ability to thrive on obstacles. These are the greatest gifts we can give our students.'(Dweck 2006)

Advice to others who want to try something similar

- Make sure that you have a good video camera with the capacity to capture good sound quality and a wide angle lens.
- Get the children and yourself, used to having their learning recorded and share with other members of staff.
- Have a brilliant TA to support you. (really important)
- Be selective! Finding activities that promote note-worthy talk can be challenging.
- Take risks.
- Analyse the video footage with the children – it is shared learning.
- Write up your notes while it is still fresh in your mind.
- Allow yourself time to succeed.

Private talk, public conversation. Mike Askew
Lyn Dawes 2008
Mercer (2008)
James Nottingham (2010) Challenging Learning
Dr Helen Drury (2015) Mastering Mathematics
Carol Dweck (2006) Mind sets; The new psychology of success

Research carried out by:
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