



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

How do low entry high ceiling (open-ended) problems facilitate talk?

Pope Paul Catholic Primary School

Context

Pope Paul Catholic Primary School is an average-sized primary school located in the Hertsmere district of Hertfordshire. The school was rated as 'good' by Ofsted in June 2016.

The focus

On Friday 18th 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 Rita Varga, Year 4 Teacher at Pope Paul Catholic Primary School.*

Lesson observation and book scrutiny at the end of last year showed a lack of application. Children in all year groups were given ample opportunities to learn new skills or consolidate their learning from previous years but challenge mainly came from more complex numbers. This didn't give pupils a platform to make connections, recognise pattern or deepen understanding. Teachers were introduced to HfL's 'Thinking Mathematically' document which gave us a better understanding of how to ensure mastery through application (conjecturing relationships and generalisations; developing an argument, justification or proof using mathematical language). The early autumn results were promising but highlighted the need for even more open ended, 'rich' tasks that would focus solely on talk without the stress of recording and which would be manageable for all (as we know Year 6 and Year 2 are SATs oriented and need something short and sharp).

From the summer term, our focus changed slightly and instead of investigating the amount of talk generated by open ended problems, we looked more closely at the quality of these conversations, especially for lower attaining children. We went back to the activities (now with the certainty that they DO facilitate talk) and started adapting them to facilitate talk on different levels. That is still an ongoing process.

Description of my approach

The starting point for change/ Resources

Shortly after attending the Great Maths conference, the leadership of the school put several strategies in place to react effectively to the new ideas promoted during the conference.

The teaching and support staff attended several staff meetings on effective opportunities for problem solving and their possible extension or tailoring to suit all needs. They were given 'starting points' such as:

The Oxford Owl Teaching for mastery document; Problem Solving and the more able child document (produced by St. Mary's RC Primary School) ; slides and tasks from Great Maths Conference; tasks produced by our HfL maths advisor; tasks produced by me following my MaST sessions at University of Hertfordshire and Inspirational Maths sessions, inspired by Joe Boaler's Youcubed website.

Teachers also had opportunities to work alongside HfL maths advisors to consult on possible problem solving opportunities or skills applied. Chatty Maths activities have been introduced in Year 4 and trial sessions in Year 1, alongside blank maths journals in Year 4 at the beginning of the summer term. As a result of the support put into place, change in books, plans and the pupils own view was apparent immediately. Evidence shows that all staff embraced the open mind-set message and the embedding process in the whole school began.

Learner's responses

As a result of the constant reinforcement of the 'Open mindset' message from September the learning environment in classes became safer enabling teachers to enrich their planning further with 'problem solving that leads to creating ideas and representations, exploring puzzles, discussing methods and many different ways of working' (Boaler 2009). Teachers' and pupils' positive attitude towards mistakes started to embed in the whole school. Teachers' were gaining confidence in choosing 'Rich tasks' that are accessible for a range of children and that allow learners to pose their own questions (J, Piggott 2008). The school started building a culture of using creative sources (such as NRich, Youcubed, NCETM website) to find and customise tasks promoting collaboration and discussion, speculation, proving and explaining, reflecting and critical thinking (J, Piggott 2008). Pupil Voice shows that most children enjoyed our Inspirational Maths sessions and a leading factor was the opportunity to talk with others that gave even the shy pupils the courage to participate. They valued the tasks as they either had lots of possible 'answers' or they did not have one at all. I noticed huge change in my own Year 4 class, where children considered only number problems as Maths and who believed Maths stops outside school. Children could access the same problem on different levels, giving space for rich conversation between partners who never worked together before, boosting the whole class' confidence.

The impact of the introduction of low entry- high ceiling tasks in Year 4 is that children have a natural urge 'to prove' their answers even when not instructed and are not 'stressed' when asked to explain their thinking. Children have a much richer vocabulary in maths and they understand the need for precise language when writing up explanations.

They value working in pairs, groups or as a whole class highlighting the effect of being able to share their thinking.

Widening the approach

Whom to work with?

After the Great Maths Conference in September, we started with a whole school focus in maths (open-ended tasks), but after two terms of consolidating my understanding and my practice of low entry-high ceiling problems, I thought it would be beneficial to explore how 'rich tasks' are implemented in Key Stage 1 therefore trialled Chatty maths slides in Year 1.

Working with another colleague:

The Year 1 class trialled tailored 'Chatty maths' sessions (12 sessions in total). The class teacher reported a lot of talk during the sessions, mostly something to do with the task. Evidence from the work books suggest that the majority of children commented confidently on what resources to use. Some of them were able to explain why they were using those (link it with earlier or similar task). The class teacher also noticed that a group of lower attaining children who wouldn't start on a problem independently before, used pictures after some discussion. Some of them were able to communicate their pictures. Children were advised to talk in their table groups. Many children expressed their thinking that there might be a hidden mistake in the task ("I think Ms Varga wanted to trick us..."). The Class teacher also noticed rich cross-curricular talk (when asked 'What did you notice?' children made links with RE). The majority of low attaining pupils openly talked about feeling stuck, not knowing what to do (not being afraid of mistakes) and asked what others thought about the task (these peer conversations then gave them a starting point they could use to access the problem).

During lesson observations, I have noticed huge change in my colleagues' attitude to the subject. They are all confidently using open questions, highlighting connections or patterns, enabling their pupils to make connections between different areas of maths. They are confident to stop lessons and use assessment for learning to tailor the task or the questions. They are also confident in extending their higher attaining children with 'mastery' type next steps in their learning.

Impact and recommendations

As a result of a whole school commitment to open ended problems, the celebration of mistakes is embedded in all classrooms. Pupil voice shows children understand mistakes as proof of thinking rather than a by-product being ashamed of. All books show evidence of 'application type lessons' where children are not necessarily grouped according to attainment rather children work on the same open problem and access them on different level. Book scrutiny shows evidence of 'NSL' (next steps for learning) promoting reasoning, finding proof using different resources or representation. Children's learning shows evidence of problem-solving early morning challenges that are also recorded in a variety of ways, like photos, or children's explanation of their understanding of a new concept. Learning walls in all classrooms focus on reasoning and proving answers; supporting the specific language needs with vocabulary cards and sentence starters. Taxonomy cards were introduced to teachers and support staff to extend lessons or to use them as possible 'NSL'. Pupil voice shows children are confident when feeling 'stuck' and name 'talking to a partner' as an option to overcome difficulty.

Moving forward:

In the future, we will need to ensure that teachers have a clear understanding of 'maths talk' as *talking mathematics* rather than talking *about* maths. New staff will be introduced to 'open' lessons and current staff will be trained in finding creative ways to record them (Learning Support Assistant notes, voice recorder, tape lessons and use them as starting point for follow up lesson).

As a whole school, we need to improve questioning and commenting techniques which avoid controlling the communication in order to get to a mathematical end and encourage mathematical thinking instead. Our maths team will provide training on scaffolding questioning techniques and customising talk for all attaining groups (LA+MA), making sure that all middle attaining children's understanding is monitored. We will also further embed short, sharp 'chatty maths' sessions in Key Stage 1.

Contact	Rita Varga, Year 4 Teacher at Pope Paul Catholic Primary School
Reading and website references	<p>Askew M., Bishop S., Christie C., Eaton S., Griffin P., Morgan D, (2015) <i>Teaching for Mastery</i>, Oxford University Press</p> <p>Boaler, J. (2009) <i>The Elephant in the Classroom</i>, Souvenir Press, London</p> <p>McAteer, M. (2013) <i>Improving Primary Mathematics Teaching And Learning</i>, OUP McGraw- Hill Education</p> <p>Pigott, J. (2008) <i>Rich Tasks and Contexts</i>, http://nrich.maths.org</p> <p>Websites:</p> <p>NRICH: http:// nrich.maths.org School website: www.popepaul.herts.sch.uk</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

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