Developing deeper thinking in Key Stage two mathematics

Renata Bobik-Dawes and **Nasreen Majid** investigate maths journals

The project's aims to develop deeper levels of thinking on mathematical processes with a group of year 5 and 6 pupils. This thinking has been facilitated through the structured use of mathematical journals that the pupils have been writing every week. The diary entries have been discussed in taught sessions in order to enable pupils to hone in on what deeper thinking looks like in the context of mathematics. The principles driving the project have been inspired by the recent work on metacognition and self-regulation from the Education Endowment Fund, (EEF, 2018).

What is Metacognition and Self-Regulation?

Metacognition and self-regulation strategies aim to engage pupils in deeper thinking about their learning processes. This is enabled by structured teaching of key strategies throughout the learning process, enabling them to plan, monitor and evaluate their own learning, (EEF, 2018). According to the EEF, (2018), clearly taught strategies that develop metacognition and self-regulation skills enable pupils to have high gains, with an average of seven months of additional progress. Finally, the professional development that can enable teachers to learn the skills to achieve these gains are cost effective, with an average spend of under £80 per pupil, (EEF, 2018).

What we did?

The project started with a survey of pupil attitudes towards mathematics. The reason for the survey was enabling a pre and post comparison of how pupils felt about their mathematics learning and if there was a change in attitudes once they had an established routine of reflecting on their mathematics learning using the journals.

The journals were introduced to the pupils and they wrote an entry every week for two terms. As the year progressed, a marked increase in deeper reflection was noticed through the journal entries. An example of timed progress can be seen in the work of Shahzaib, a pupil in year 6 in Figure 1A, 1B, 1C.

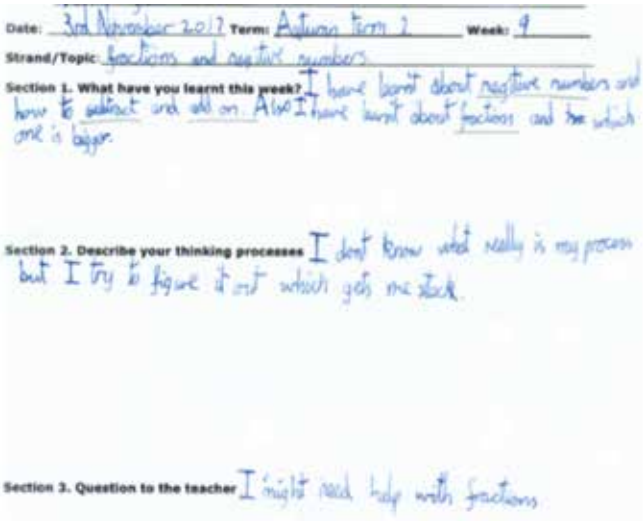


Figure 1A Year 6 Pupil struggling to describe thinking processes at the beginning of the study

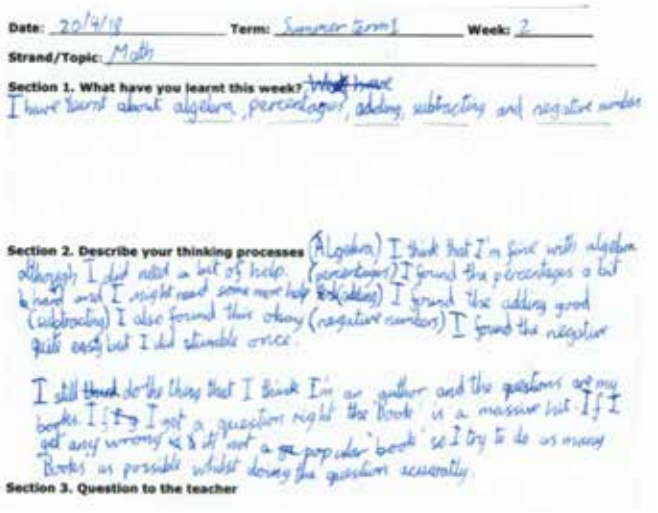


Figure 1B Year 6 Pupil describing and evaluating in detail performance in lessons as well as using analogy to explain thinking

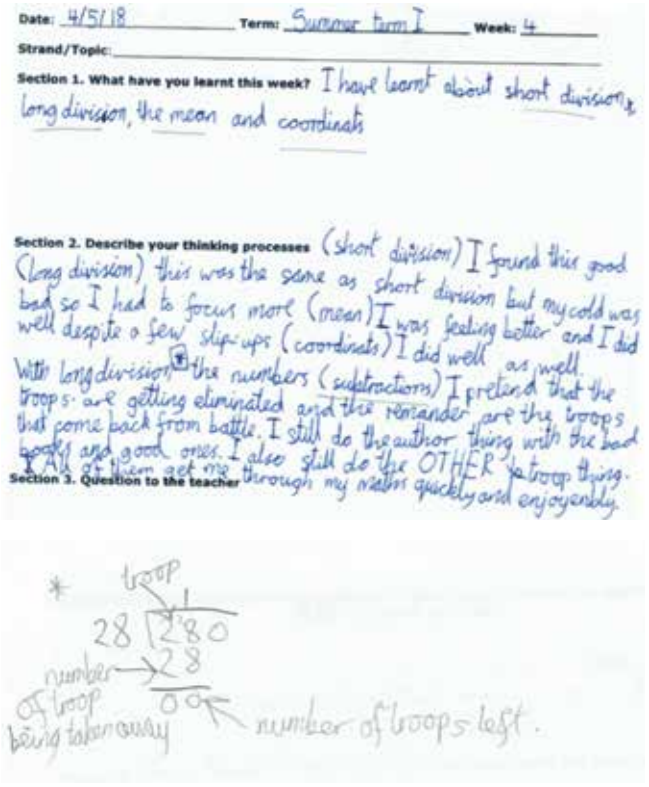


Figure 1C Year 6 Pupil evaluating work done within a week and using analogy to describe thinking when doing division

Another clear trend noted was the use of models and images to describe mathematical processes and thinking. Some examples can be seen in figure 2A, 2B, 2C.

Summary

Early evaluation of the study are encouraging as the use of reflective journals in mathematics has enabled gains for pupils in their mathematical thinking. Additionally, the journals have and continue to act as formative assessment tools for the class teachers to support future learning and planning of mathematics. Furthermore, it enabled the pupils to take individual and collective responsibility for their learning in order to become successful mathematicians.

Therefore, as researchers both Renata and I are excited to continue this project and measure outcomes of cohorts taking part in the project in academic year 2018–2019.

We are grateful for the work of the EEF, (2018) to provide us with a clear tool kit to enable us to develop a bespoke project that has captured mathematical thinking in the classroom. We hope to be in a position to write up the findings for a journal article focused on practitioners.

I will leave you with a final comment from one of the pupils' from the study:

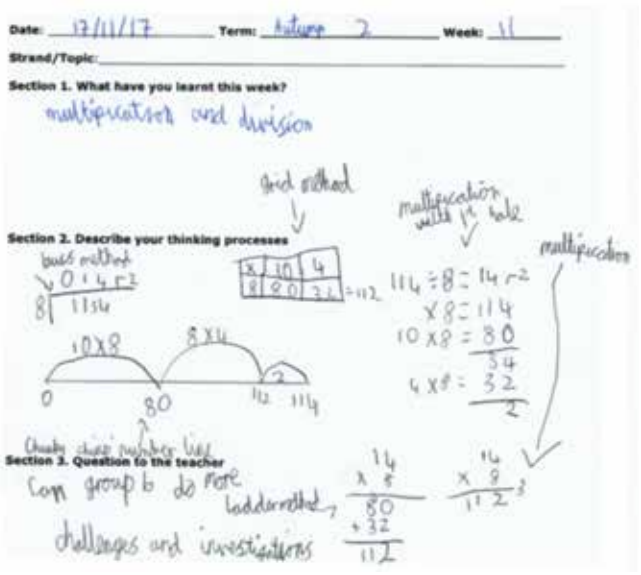


Figure 2A Year 5 Pupil presents selection of methods used in a week using key vocabulary when describing thinking processes

Figure 2B Year 6 Pupil describes steps in multiplication of decimals when describing thinking processes

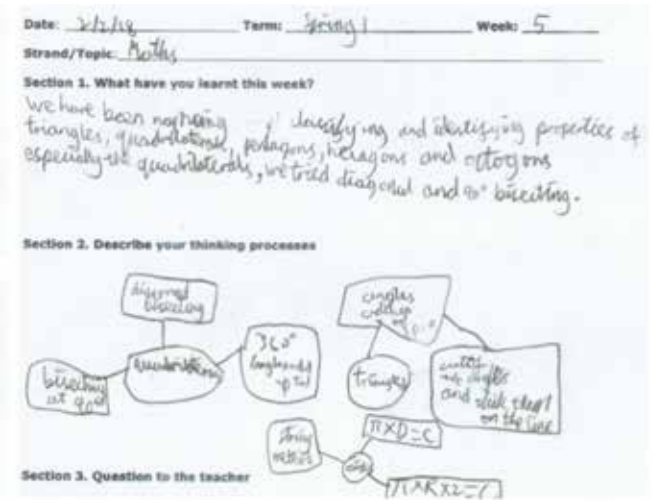


Figure 2C Year 6 Pupil using mind mapping to present thinking skills and conceptual understanding

'I think that the mathematical journal has really helped me develop and understand my mathematics skills better than I have ever before…. This year you have opened up my mathematics vocabulary and interest.'

References

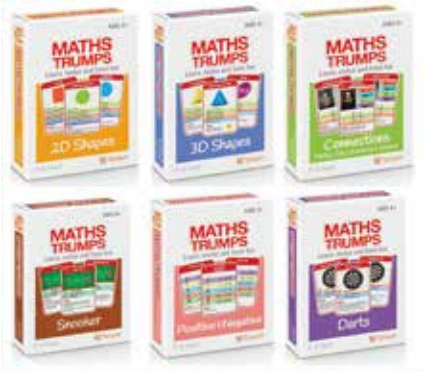
EEF. (2018). Metacognition and self-regulation: Teaching and Learning Toolkit Education Endowment Foundation April 2018 available at: **https://educationendowmentfoundation.org.uk/evidence-summaries/teaching-learning-toolkit/metacognition-and-self-regulation/**.

Nasreen Majid is a Lecturer in Primary Mathematics at The University of Reading **n.majid@reading.ac.uk** and **Dr. Renata Bobik-Dawes** is a Specialist Mathematics teacher at St Joseph's College, Reading **renata.bobik-dawes@sjcr.org.uk**

BOOK REVIEW

Maths Trumps

Author: **P A Hunt**
Publisher: **Tarquin.**
Price: **£6.95 per set or £39.60 set of all 6**
website: **https://www.tarquingroup.com/maths-trumps-set-of-6.html** or **Amazon**



Maths Trumps are a card game with six sets focussed around shape and number. The Year 5 class that played them were familiar with 'Top Trumps' as a game and so with a quick read of the instruction cards could access them with ease. What struck me immediately was the real sense of enjoyment and laughter you could hear from groups playing across the classroom. The question challenges gave children opportunities to consolidate and extend their knowledge beyond the curriculum, use strategic thinking and engage in explanatory and questioning-type dialogue. Observing pupils play also provided me with a useful time to step back and listen; listen to the strategies children were using, to how they were applying their mathematical knowledge and to the specific reasoning they were using to solve the challenges.

In one exchange, children were curious to find out and ask each other about the properties of shape in order to help them choose a category:

T: Would this trapezium's lines count as parallel lines? Oh yes they would, wouldn't they. Would these lines on the side count as parallel? Oh no, they wouldn't be because they would never meet.
F: I've forgotten; what's so special about an isosceles triangle?
K: Is it because it has two equal lines?
M: Yes – this one is a right-angled isosceles triangle because it has a right angle here but the other line is longer.

These types of group interactions were typical in being of a curious and playful nature. Children wanted to find out content knowledge they did not know in the game and learn from their mistakes:

F: I chose number of sides because I thought I would win but B won because he had a hendecagon. Oh no!
N: (Pointing to a nephroid shape) Is this a line of symmetry? It looks like a… (laughs). Is this a line of symmetry (points diagonally)?
K: No it's not because if you reflect it, it won't be the same.
M: It has two lines of symmetry because only the vertical and horizontal lines are.

As one student pointed out, a challenge to using this game within whole-class teaching would be matching the level of the questions with the appropriate level of challenge for pupils: *'It was fun but the negative numbers one was a bit tricky. It's a fun way to learn maths but not so much if the questions are too hard. I think it's important the questions are just right.'* For this reason perhaps, the game might be best suited to continuous-type provision. As such 'Maths Trumps' appear to provide a motivating, educational experience for children to engage in mathematical thinking as well as supporting the development of important positive attitudes and enjoyment of maths. As one child put it simply, *'I really like top trumps generally and I like maths at school so it's a mix of two of my favourite things!'*

Luke Rolls