WHAT IF MATHS IS TAUGHT TO OLDER PUPILS THROUGH MATHEMATICAL STORY PICTURE BOOKS?

Natthapoj Vincent Trakulphadetkrai
Institute of Education, University of Reading

Annotatsion*: Learning mathematics through reading and creating mathematical story picture books can be a powerful pedagogical strategy for older primary school pupils, but first, what are mathematical story picture books?*

KEY CHARACTERISTICS OF MATHEMATICAL STORY PICTURE BOOKS

Just like any story picture books, mathematical story picture books (MSPB) also have a plot, a cast of characters and page illustrations. What makes MSPB unique is that mathematical concepts are either explicitly or implicitly woven into the plot to either demonstrate the concept or show how the concept can be used by characters to solve a problem found in the story. Take, for example, 'Fractions in Disguise' (Einhorn, 2014). This story is about George Cornelius Factor (GCF) who invents a machinecalled 'Reducer' to help him find a very sought-after fraction (5/9) that has been stolen from a fraction auction and has been disguised as another fraction by the villainous Dr. Brok. While at Dr. Brok's mansion, GCF uses his knowledge of equivalent fractions (in the form of the Reducer machine) to reveal the true form of a range of fractions (e.g. 3/21 is really 1/7; 34/63 is already in its true form; 8/10 is really 4/5, and so on). Finally, GCF comes across 35/63 which is later revealed as the 5/9 fraction he has been looking for. When we examine the above story structurally, we will see that mathematical knowledge (i.e. knowledge of equivalent fractions) is required to help the character solve the problem. The page illustrations also help readers visually see how 35/63 is in fact the same as 5/9. In brief, MTSB are a specific genre of literature, and they are not (and should never be) mathematics textbooks or worksheets in disguise. Moreover, as the above story shows, MSPB are more than just counting books. There are several MSPB that focus on mathematics concepts for upper Key Stage 2 pupils (9-11 year olds), such as any titles in the Sir Cumference series. Furthermore, there are also several MSPB with a focus on mathematical concepts for Key Stages 3 and 4 (12-14 year olds), such as 'What's Your Angle, Pythagoras?' (Ellis, 2014) for Pythagoras' theorem, and 'Anno's Magic Seeds' (Anno, 1999) for exponential growth, among several others.

WHY SHOULD WE TEACH MATHEMATICS TO OLDER PUPILS USING STORY PICTURE BOOKS?

The idea of using MSPB to enrich mathematics learning is not a new idea. In fact, it has been around for almost three decades, particularly in the early years setting. What is less common, particularly in the UK, is using MSPB to enrich mathematics learning beyond the early years level. I have been arguing - and will continue to argue - that the approach could also benefit mathematics learning of older pupils. Specifically, I would argue that the use of MSPB could: Natthapoj Vincent Trakulphadetkrai

L. Harbison and A. Twohill (Eds.) Proceedings of the Seventh Conference on Research in Mathematics Education in Ireland (MEI 7)2foster pupils' conceptual understanding through multi-representation of mathematical concepts and variation of mathematical situations; develop language skills; and foster engagement with mathematics learning. Foster conceptual understanding through multi-representation We can all (hopefully) agree that we do not teach mathematics so that our pupils become a human calculator, that is someone who is good at churning out correct mathematical answers but without conceptually understanding the concept behind it. As part of one of my research projects, when Jack (pseudonym), a 9-year-old pupil, was asked by me what 20 ÷ 5 equals, he was able to give me the correct answer (4) almost instantly. Then, when he was asked to (contextually) represent 20 ÷ 5 using a word problem, this is what he cameup with: "Spanish Yoda had a can of Coke and a bag of bananas and apples and paint. How much did it cost her? Coke: £1.00. Bag of bananas: £2.00. Apples: £8.00. Paint: £9.00. Total £20.00". How Jack's word problem is related to 20 ÷ 5 remains a mystery. What Jack demonstrates here is a classic example of pupils whose procedural fluency (i.e. the mechanic aspect of mathematical learning) in relation to division is good, but have yet to fully grasp what the concept means conceptually. As many mathematics education scholars have argued, in order to demonstrate conceptual understanding in mathematics, pupils must be able to represent mathematical concepts in different ways using different representations (e.g. contextualisation, visualisation, etc.). Here, I would argue that key features of MSPB, such as narrative and page illustrations, make learning mathematics conceptually effective as pupils get to learn mathematical concepts through these different representations. Foster conceptual understanding through variationAnother key strength of teaching mathematics using MSPB is the development of pupils' conceptual understanding in mathematics through what I refer to as the variation of mathematical situations that are often found in well-written MSPB. To explain this concept, take 'Bean Thirteen' (McElligott, 2007) as an example. The story follows two crickets, Ralph and Flora, who have collected twelve beans to bring home for dinner. When Flora decides to pick one more bean (i.e. Bean

Thirteen), Ralph is convinced it will bring bad luck. No matter how many friends they invite to try to share the 13 beans equally, it is always impossible. Situation 1: 13 beans to be shared between 2 crickets (Ralph and Flora) resulting in 1 remaining bean (6 beans each) Situation 2: 13 beans to be shared between 3 crickets (Ralph, Flora and 1 friend) resulting in 1 remaining bean (4 beans each) Situation 3: 13 beans to be shared between 4 crickets (Ralph, Flora and 2 friends) resulting in 1 remaining bean (3 beans each) Situation 4: 13 beans to be shared between 5 crickets (Ralph, Flora and 3 friends) resulting in 3 remaining beans (2 beans each) Situation 5: 13 beans to be shared between 6 crickets (Ralph, Flora and 4 friends) resulting in 1 remaining bean (2 beans each) Natthapoj Vincent Trakulphadetkrai

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