Teaching Elementary Mathematics to Struggling Learners
Bradley S Witzel and Mary E Little
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I read this book from the perspective of a Functional Skills and GCSE maths lecturer at a FE college in the UK, as a parent of a primary school child, and as an associate professor at a UK university in which I have supported face-to-face and global distance learners in refreshing their maths skills at the start of their MSc programmes in public health and related subjects.

The book is written in the context of the schooling system in the USA and, without a glossary of terms, I found I got lost at times in unfamiliar acronyms. That said, there is much that is relevant or fairly easy to

translate across to other contexts. Two aspects caught my attention in particular in terms of relevance to a UK context, namely metacognition and mastery. Metacognition and related prompts are raised at several points in the book, including p.26, p.32-34, p.49 and p.88-89, which link directly to the newly introduced aspects of Task 1 in Functional Skills maths at Level 2 (City & Guilds). Mastery learning, as discussed in many UK schools,[1] is introduced on p.12-13 and is revisited regularly throughout the book.
I would say that the book is a useful addition to the bookcase of anyone involved in teaching or supporting learners with maths in the UK from primary school up to Foundation-level GCSE or Functions Skills level qualifications. I expect that the book has broader relevance beyond this but cannot fully comment on this, given my own contextual experience. I would add, though, that the initial pages of the book feel very much to be written by mathematicians for mathematicians, for example, folding figure 1.1 into three-dimensional figure 1.2. There are some powerfully motivational statements and information given, although potentially 'preaching to the converted' with the likely readership. I hope to see more messages like this reaching those in educational policy and school leadership roles, as well as parents/carers.

In a similar way to how children in UK schools are encouraged to read a little every day at home (starting in reception year), and there is even continuation through the summer holiday with the Summer Reading Challenge run through libraries, children need to be encouraged and supported to do a little maths every day at home from the same age. The authors stress the importance of this by citing the 2011 Skills for Life survey conducted in England (p.vii-viii). This survey concluded that "A range of personal characteristics were linked to poor literacy and numeracy skills, including poor qualifications, level of parents' education and attitudes to learning and skills."[2] Given the negative or dismissive attitudes towards maths that are too commonly held by parents (and even some teachers), often linked to their own difficulties or school experiences with maths (p.5-6), there are obviously some deep-rooted hurdles to overcome first to better support parents/carers and teachers in their contributions to breaking this cycle so it is not transmitted to future generations. Children need immersing in maths from an early age, as happens more readily with language.[3] In fact, Witzel and Little argue in their book that maths is a language (p.40), but I would not go as far as they suggest to say I am bilingual since I 'speak' both English and maths!

I personally found this book helped me to think more deeply about the specific struggles learners may have with particular types of maths questions, and evidence-based techniques to assist them more effectively. Some techniques struck me initially as over-complicated but I am keen not to let my own comfort with maths impede supporting those who struggle. The "concrete-representational-abstract" (CRA) sequence, introduced on p.26-27 and embedded throughout with valuable applied examples (e.g. p.61, p.85, p. 111 and p.128), especially aided me here, as did the "Universal Design for Learning" (p.27), "total physical response" (p.44), Frayer models (p.44) and "incremental rehearsal" (p.90). In terms of practical examples for the classroom, I found chapters 3, 6 and 7 to contain the richest set of helpful illustrations. In contrast, the appendices of chapters 2 and 9 were more useful in this regard, with what remained in these chapters otherwise being rather dry.

My main disappointment, through no fault of the authors, was the lack of research conducted into methods beyond basic arithmetic, for example to support the learning of geometry and algebra among those who struggle (p.119 and p.138). Chapter 7 highlights the importance of geometry in everyday life, providing a neat list of related jobs (p.119). The dependence of geometry on algebra is made in chapter 8 (p.122 and p.125), with the authors also emphasising the importance and breadth of algebra, including in real-life problem-solving, calling for the introduction of algebra (or algebraic thinking) into elementary schools (p.134-135). I totally endorse this view and add further that, while I accept that arithmetic is a key foundational area of maths, I am repeatedly frustrated by the narrow lens of 'numeracy' when used as an indicator or proxy for 'maths' skills. The examples provided in the appendix to chapter 8 are more about algebraic thinking or what might be termed 'pre-algebra' whereas I wonder whether introducing algebraic notation at earlier ages / stages may help minimise the risk of learners finding this such a challenge later on, perhaps in line with the thinking around the excellent pre-school example of the introduction of negative numbers in gardening (p.99-100).

I propose that simple algebraic notation could be introduced to extend lessons, for example when learning that dividing any number by one does not change that number. Whole numbers could be used

with the CRA approach for the concrete illustration that 5 sweets shared among just 1 child means that that 1 child has all 5 sweets. After several other concrete numerical examples, some further examples could then be drawn for the representation stage. Moving to the abstract, higher numbers could be covered, e.g. 974 sweets shared among 1 child leads to that 1 child having 974 sweets. Finally, the abstract algebra could become w sweets shared by 1 child leads to that 1 child having w sweets. The learners could then choose their own letters or appropriate self-made symbols to embed this concept, explaining that the letter or symbol represents the number of sweets, which could be any amount. Discussion could follow of considering different items other than sweets and perhaps animals instead of children. I welcome feedback from others on this proposition to generate some debate and discussion on this topic in the hope that we can move towards pedagogical advances in this regard.

References

1. National Association of Mathematics Advisers. (2016). Five Myths of Mastery in Mathematics. Accessed 7 September 2016 via http://www.nama.org.uk/Downloads/Five%20Myths%20about%20Mathematics%20Mastery.pdf
2. Department of Business, Innovation and Skills. (2012). The 2011 Skills for Life Survey: A Survey of Literacy, Numeracy, and ICT Levels in England. (BIS paper no. 81, p.370). London UK. Accessed 7 September 2016 via https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/36000/12-p168-2011-skills-for-life-survey.pdf
3. Participant discussion during “Getting Maths” workshop hosted by the Society for Research into Higher Education, London (March 2016).