Book review

by Alf Coles.

Mathematical thinking in the lower secondary classroom. Edited by Christine Hopkins, Ingrid Mostert and Julia Anghileri. Published by Cambridge University Press, 2016. ISBN: 978-1-316-50362-1

This book is the first one in a series on *Mathematical Thinking*, being produced by the African Institute for Mathematical Sciences Schools Enrichment Centre (AIMSSEC) and published by Cambridge University Press, with contributions from many ATM members. The website (http://aimssec.ac.za/) contains details of forthcoming books, whose relevance and potential reach extend well beyond Africa.

AIMSSEC was set up in 2003 by Toni Beardon, who founded NRICH; it is a not-for-profit organisation that offers professional development to teachers, advisors and teacher trainers involved in mathematics in schools in South Africa. The heart of *Mathematical thinking in the lower secondary classroom* is a section containing 20 workshops for teachers, a distillation of the activities and courses offered by AIMSSEC, which have been trialled and tested and refined over the last 14 years. There are activities here that I see as classically 'ATM' and for anyone new to the organisation, this is as good a way as any to get a sense of its collective history. The idea of the book is that the workshops will provide material and stimulus for a group of teachers to collaborate, each workshop lasting up to 2 hours. There is also an introductory section, on six teaching strategies (I particularly liked "visual and practical learning" and "people maths") and a concluding section discusses teaching and learning with technology and approaches to formative assessment.

When I was head of mathematics in a secondary school, I could imagine using one of these workshops as the content for a department meeting. Advice I was given (by Laurinda Brown) that I always found useful, was a technique for creating time in meetings for curriculum development, by never using them as a space for discussing decisions. If something needed a decision, a head of department can take it upon themselves to speak to each teacher in the department individually and get a sense of their views. If most seem in favour, then the item can be raised and quickly agreed to; if it is clear there are significant disagreements, then there is no point in raising the issue at a meeting and instead, more work is needed to find alternative courses of action. Any items of information can be put on a piece of paper, so that only clarifying questions need be discussed as a group and the rest of any meeting time can be for working on some mathematics together!

Each workshop in the book is a chapter that follows the same 8-page format. The first page links the workshop to one of the teaching strategies from the first section, there are then two pages of activities for teachers (the basis of the workshop) followed by activities for the classroom. The teacher and classroom activities parallel each other but of course with a different focus. There are then 2 or 3 pages discussing "Changes in my classroom practice" and these link back again to the teaching strategies in the first section. With some workshops there are photocopiable resources within these 8 pages or in an appendix.

One chapter that caught my eye, and gives a good flavour of the whole book, was Chapter 8 "Functions and inverse functions". The relevant teaching strategies suggested were "visual" and also "getting feedback". The activities (for teachers and classroom) centre around a description of the "Function game". This is an activity that has a rich connection to ATM. It's likely first description is in *Starting points* (1972) by Banwell, Saunders and Tahta; there is also a description of the game in the publication *An addendum to Cockroft* (1982) by Brown and Waddingham, available (for free) on the STEM website (https://www.stem.org.uk/elibrary/resource/31296). In essence, the teacher has a rule in mind (for example, 'double and add one', writes on the board a couple of input/outputs and then invites the class to complete the next one, so the board (for a different rule!) might look like:

2 -> 5

6 -> 37

4 ->

At which point, the pen is offered to the class; a student volunteers to come to the board and complete

the output. The teacher can respond with a J or a L. As suggested in this book, the game is best played in silence.

The 8 pages of this chapter give as good an introduction as is possible in text, to this complex and powerful activity. The chapter is a good example of how collaborative working is so important – if you have not seen the game used before, I imagine it is hard to get a sense of possibilities. However, working together with other teachers (as is intended in the book), it would be possible to get a sense of how this activity might work in the classroom and what it could lead to.

My paradigmatic example of the function game was seeing Laurinda Brown play it with a year 8 class of mine. There are existing videos available, for example, on the video mosaic website (http://videomosaic.org/home) there are clips of teachers (e.g., Arthur Powell who was a collaborator with Gattegno) and others using this activity, which they label "Guess my rule" (you can search under "Select a Math Problem". There is a (not very good quality) video of my own

use of the game, on the NRich website (http://nrich.maths.org/6808&part=), this was a slightly artificial situation in that it was an invited group of students at the school where I used to teach, rather than a real class and I think the video (partly as a result of its editing) fails to give much sense of the slow pace and the way that focus and concentration can build.

I remember when I first saw Laurinda use this game, I thought that she needed to publicise 'function game for the world' as it just seemed so powerful – with students visibly excited at grappling with algebraic thinking. I would hesitate to be so sweeping these days, but I am delighted that this current book is contributing to just that agenda!

Ideas within the workshops will be known to some readers but their presentation, aimed first at teachers and then at the classroom, works effectively and is timely. It is surely our awarenesses as teachers that we need to develop, in order to better meet the needs of our learners, and it is equally sure that this is most effectively done collaboratively. This book is certainly one I would want on the shelf in my department.

How many cranes?

Paul Stephenson offers a problem for you to work on with, or without, your students.

Things are easy to count as long as they do not move. The magic of photography achieves this. Without a camera you have to make a snap judgement. Pattern helps. The number of circles on the right is clear, but on the left? I would guess more than 50 but I could not tell you whether the number was nearer 50 or 100.

Try the circles, then the cranes. First make your 'snap judgement', then count them one by one. To see a full sized image of the cranes go to http://magicmathworks.org/wp-content/uploads/How-many-cranes.pdf.

In the case of the cranes a serious observer would aim at a number accurate to one significant figure. The cranes were photographed as they passed over the Ruhr on their autumn migration from Scandinavia to southern Spain.

Paul Stephenson is operations director of The Magic Mathworks Travelling Circus.

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