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Quality, passion and ingenuity

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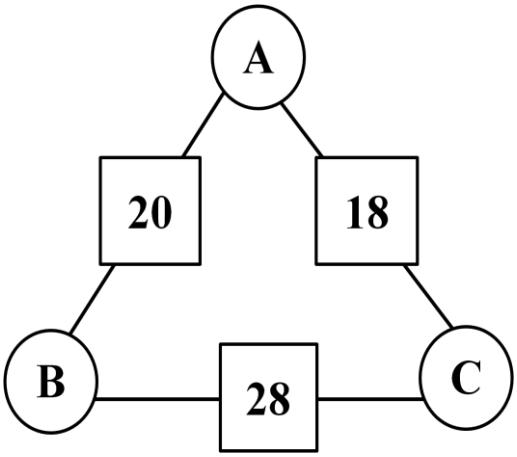


The numbers in the squares are the sums of the two adjacent numbers in circles.

Example, A+B=20

Find A, B and C.

(DfEE, 2001, page 123)

Quality

Leading the Institute of Education PGCE Maths course, I have the privilege of working with some of the highest achieving graduates in the country. One of the questions for the review is how the government can encourage more high-achieving graduates to become maths teachers. Of course, there is more to being a good maths teacher than being good at maths. You have to want to work in a classroom and like doing so. You have to be interested in the idiosyncratic mathematical ideas that children come up with. We know that good maths teachers have a quality of knowledge beyond being able to do the question.

Connection

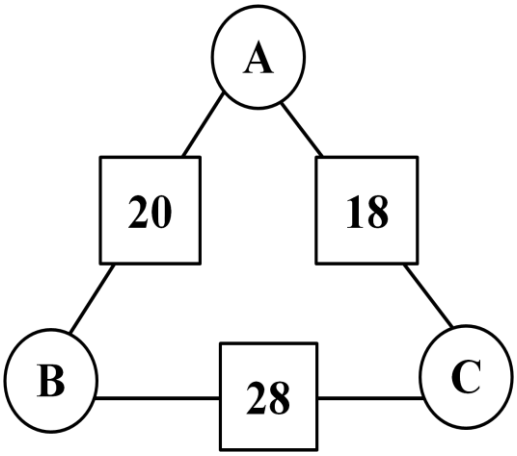
I want to make connections between knowledge for teaching; curriculum and assessment systems; increasing participation in mathematics post-16; and the kind of schooling that will prepare our children for their adult lives.

Passion

According to a number of studies (for example, Boaler et al., 2000, Brown et al., 2008, Nardi and Steward, 2003) many children dislike their experiences of school maths and there are 16 year olds who would rather die than carry on with it. Reasons given across all abilities for this include: rushing on before they understand properly; pointless procedures to learn (often by rote) for the exam'; and little purpose either at the time or for the future. In parallel to this, in London, we are struggling to get 50% of our maths teachers to stay in teaching for more than five years. Their passionate desire to help children to understand, enjoy and even love maths is frustrated in the face of over-monitored progress. The new curriculum, assessment and accountability system must remove this frustration and put the means to help children love maths back into the hands of maths teachers; otherwise we won't keep them.

Problems

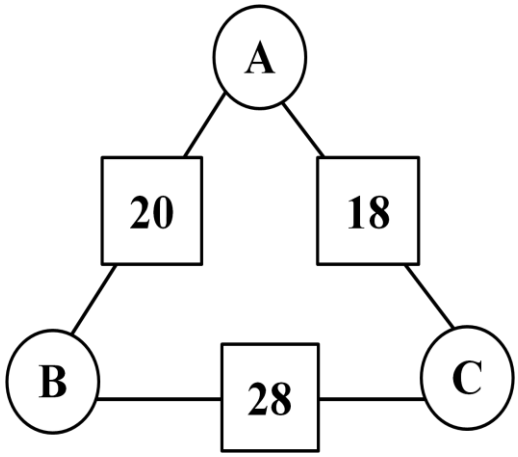
Let me illustrate with a problem. I have set this problem to literally hundreds of trained mathematicians over the years. By trained mathematicians, I mean final year undergraduates and postgraduates in mathematics and related subjects. Most of them (and I mean over 90% of them) form simultaneous equations and solve them like this.



Eq.1:	A+B=20
Eq. 2:	A+C=18
Eq.1 – Eq.2 = Eq. 3:	B-C=2
Eq. 4:	B+C=28
From Eq. 3 + Eq. 4:	2B=30
	B=15
Substitute B=15 into Eq. 1:	A+15=20
	A=5
Substitute A = 5 into Eq. 2:	5+C=18
	C=13

There is, of course, some variation in the choice of equations formed; for example, some choose to form B+C=28 as Equation 1 and go from there. There are also choices about what to substitute.

In the KS3 Framework, this problem appeared in the year 8 programme as a mathematical context for “forming and solving linear equations” (DfEE, 2001, page 123). We let A = x. (Why not let it stay as an A?) Then we form expressions for the numbers in the other circles, (20-x) and (18-x), form an equation in x and solve it.



(20-x) + (18-x) = 28

.:38 – 2x = 28

2x = 10

X = 5

So A = 5, B = 15, C = 13.

My well trained mathematicians are sometimes uneasy they didn’t think of this simpler solution but then I offer them the ingenious solution, which they normally find delight in.

Ingenuity

Years ago, I gave this problem to one of my year 7 classes without an explanation of how to solve it. One pupil noticed that the difference between 20 and 18 is 2 so; since A is common to two sides, the difference between B and C must also be 2. For that pupil, the new problem was to find two numbers, B and C, with a sum of 28 and a difference of 2.This was completed with quick mental arithmetic. "*And now I can work out A.*" That's the best bit for me; the implicit generalisation that we know enough to work out A. She knew she could solve it and every other question like it. So my question is who would you want working for you?

Change

Where teachers have successfully changed attitudes to learning mathematics, learners report opportunities to think for themselves, to try out their own methods and to have time to reflect. High achieving graduates also want this; you don't get high achieving graduates following a poor curriculum; they want some control over it; to make it better. Making the solution of unfamiliar problems central to the curriculum makes creative teaching possible as long as we don't get the same unfamiliar problems recycled every year! I recall a quotation from a video you may have seen called "Shift Happens" originating from a high school administrator in the United States by the name of Karl Fisch. "*We are currently preparing students for jobs that don't yet exist using technologies that haven't yet been invented in order to solve problems we don't even know are problems yet*." (Fisch and McLeod, 2007)

We can't afford to wait any longer to give children a variety of problems to solve and to acknowledge and praise their ingenuity rather than smother it with the need to *do it this way because the mark scheme says so*.

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