From ATM’s Professional Officer

In August I went back in time to when I was taking my O-levels in the late fifties. I played the role of the chief examiner in the Channel 4 TV programme That’ll teach ‘em. The teacher who taught pupils ‘fifties-style’ maths for four weeks thought that teaching the pupils to do complicated arithmetic was a priority. This was one of the questions they had to answer:

1. Mathematical tables must not be used in this question.
   (i) Express 2 ft. 5 in. as a decimal of 1 yd., correct to three decimal places.
   (ii) Simplify $3 \div (2 \frac{1}{3} - 1\frac{2}{3})$.

Even though the pupils involved in this project were expected to do very well in their GCSEs, I thought they would find difficulty with arithmetic questions like this. But they all answered it with ease. Young people today are sometimes criticised by employers and others for their poor numerical skills – this seems to show that, if we chose to spend more time teaching numerical skills and techniques, then young people would soon acquire them.

As I marked more of the papers I realised that the pupils were having difficulty getting started on problems where they had to select the strategy and skills to use. I was back to the phenomenon I wrote about in my last Update, where I expressed surprise that a group of bright pupils I was working with appeared to have little experience of sustained working on non-routine problems.

The O-level questions rarely used diagrams to help pupils. I thought the following question should not have caused difficulties, but only two of the 28 pupils made any progress with it. Most appeared unable to draw a diagram.

4. ABCD is a rectangle and equilateral triangles $AXB$, $BYC$ are drawn, $X$ and $Y$ being outside the rectangle.
   Prove that (i) the angle $AXD$ = the angle $BXY$;
   (ii) the triangle $XDY$ is equilateral.

This led me to thinking how I might work on this problem with pupils today. Maybe I would give them the first sentence to start with, and ask them to draw what it is describing. Once they have sorted that out I would use a dynamic geometry package to offer them figure 1.

I would then ask them what they notice as rectangle $ABCD$ is dragged around the screen: hopefully, that triangle $XDY$ looks as if it is equilateral. Closing the rectangle down until it disappears and then opening it out may help pupils focus on the size of angles $AXD$ and $BXY$. So already the learners may be suggesting their own theorem and may be gaining some insight into a proof of it. And watching this image may persuade them that triangle $XDY$ is equilateral, which may motivate them to work on the proof. It may be necessary to point out to pupils that, even though we can be pretty certain from the dynamic image that the triangle $XDY$ is equilateral, we still need to prove it. This type of discussion may help pupils to understand better what ‘proof’ means and why a proof is needed.

Dynamic geometry also makes it easy to ask ‘What if not?’ questions. So what if $ABCD$ is not a rectangle but a parallelogram? (figure 2)

So what can I learn from my journey back to the fifties? GCSE maths today is more accessible and more people are successful. This means that a greater proportion of the population have opportunities that would have been denied them in the fifties. But is this at the expense of not stretching our most mathematically gifted young people? Universities complain that their undergraduates with good A-level maths grades lack algebraic fluency and ability to solve problems. So maybe there are some lessons we could learn from the fifties – at least for our most gifted pupils: more non-routine multi-step problems, more emphasis on exact solutions using algebraic manipulation and more appreciation of the nature of proof.

Barbara Ball
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