

[The importance of problem solving]

So let's take it as a given that mathematics is generally important. What are your thoughts on problem solving? Did you enjoy it in school? Did problem solving just seem like a whole lot of trick questions and unreal scenarios? Were most problems you encountered simply dressed up versions of routine problems? Let's ask ourselves: What makes a good mathematician?

We might think of mathematicians being good at recalling mathematical laws and facts, being good at arithmetic or able to do large sums in their head, being at ease with algebra or being really fast at computations that take us a long time. However there are also other traits of great mathematicians that are sometimes forgotten about: mathematicians should be able to solve new types of problems by adapting their existing knowledge, they can see relationships or might find novel and efficient new ways of doing things and add to this that they don't give up easily and persist (hopefully with a positive attitude), can communicate their ideas well, are organised when approaching problems to avoid retreading dead-end paths, and they reflect on the broader implications of the problem they've solved, reviewing their findings. So on the left, we have some skills – the mathematician certainly can't do without these, but on the right are those skills that allow the mathematician to solve real world problems or problems that no-one might have been able to solve before. We'll call it the x-factor. Mathematicians need both types of skills, without being flexible, without being able to communicate, algebra and computation will only ever be able to solve problems that don't advance our understanding of the world. In fact, some of the right-side might seem like they aren't necessarily specific to mathematics and of course, this is true.

If we take basketballers – there are skills, like shooting, dribbling, passing and defensive skills, but then there are also other traits like being able to read the game or having a “high basketball IQ”, being

able to handle pressure, being a team player, they often talk about MVPs making everyone on their team better with leadership, perseverance, and a drive to never stop improving. Artists too: of course there are the skills: drawing, painting, being able to use their different mediums and design principles like balance, lighting etc, however then great artists also need to be imaginative, develop their own style, be able to communicate and connect with their observers, being able to innovate and of course the dedication and commitment it takes to make it as an artist.

A problem with mathematics, which maybe isn't true with some other professions, is that we spend a lot of time working on the bread and butter skills, and never get to the creative and exciting parts of being a mathematician. However a classroom with problem solving can help do this – not to say that it's easy, and certainly even problem solving needs to become something of practice – problems need to be set at the right level, but this is where a mathematician gets to bring all their skills together.

However one thing to bear in mind, both as a mathematician yourself and in helping others: Problem solving can be confronting. Students who might usually perform well on routine tasks can be faced with being 'stuck'. Students can be uncomfortable with the idea of there being no 'correct' solution. Teaching problem solving takes time, patience, and requires you to resist solving the task for the student

And lastly, Problem solving is hard to assess – any problem that might be genuine for students can be solved routinely if students already know the path to take.