The NCETM Maths Podcast Episode 78

I Can't Do Maths - Part 1

Julia Thomson: Hello and welcome to the NCETM Maths Podcast. I'm Julia Thomson [JT] from the NCETM Communications Team, and for this episode of the podcast, I'm talking to Professors Alf Coles [AC] and Nathalie Sinclair [NS] about their book, *I Can't Do Maths! Why children say it and how to make a difference*. In the book, they unpick five key maths dogmas or myths that as teachers we'll all be familiar with.

Alf and Nathalie were so generous with their time, and I couldn't resist asking them lots of questions about their book, so it was quite a long conversation. We've cut it into three parts to make it a little more manageable. In this first part, I speak to Nathalie and Alf about their first two dogmas, which are that maths is a building-block subject and that maths is always right and wrong. I really hope you enjoy this first part of our conversation.

Thank you both so much for taking the time to speak to me today. I'd like to start by asking you to tell our listeners a little bit about who you are and what you do. Nathalie, can we start with you?

NS: Sure. My name is Nathalie Sinclair and I'm a professor at Simon Fraser University in British Columbia in Canada.

And I do research around the use of technology in math education, special interest also in geometry and in trying to understand the role of the body, including emotions in thinking and learning mathematics.

JT: Alf, if I can come to you.

AC: Thanks. So, my name is Alf Coles. I'm a professor at the University of Bristol in England.

Some of my research is around teacher education. I'm also increasingly interested in what climate change means for maths classrooms. I taught for about 15 years in secondary schools before moving to the University of Bristol. And I guess, also a relevance, I was one of the educational consultants on the NCETM professional development resources for primary mastery.

JT: Yes, I've seen your name in various places. That's fantastic. So, in your book, you present five common myths about teaching and learning maths, which you refer to as dogmas. What was the process which brought you to focus on the five particular myths or dogmas that you explored in the book?

NS: It was actually Alf's idea, and I think he actually had myths as the original idea, which is what you just said, Julia, and I think I suggested that we move towards the language of dogma. ‘Myth’ has this idea that it's probably wrong or made up or something like that.

And dogma for me came with the idea that there's some truth to it somehow. It comes from some kind of source in evidence or experience or whatever, but that it might not be the whole story and that it might depend on what your assumptions are. And we really wanted to move towards that language so that we weren't sort of saying: ‘Oh, things are either this way or that way.’

Both Alf and I spent a lot of time with teachers, talked with a lot of parents, a lot of children, and these five dogmas kept coming up over and over again. They're also really strongly situated in the history and philosophy of mathematics and go all the way back to Plato's understanding of mathematics, which is why we wanted to bring those ideas to bear. I think it's helpful to understand, okay, if for 2,000 years we've been told that this is how things are, no wonder it's so hard to move away from those assumptions.

JT: I was going to ask you about dogmas because it's a very particular choice of word, isn't it? The word dogma, and it's normally used in relation to religion and the idea that it's a set of beliefs that's incontrovertibly true. And I think it sometimes is difficult for teachers to question those beliefs and think, can I do something differently? Is that what you want your book to do really? To get people to question some of the ideas that they might have been taught or that they might be very strongly wedded to, I suppose.

AC: I think we'd be delighted if the book provokes people to try out new things in the classroom and potentially rethink some of the ideas that we're putting into question.

We've been keen to include some practical suggestions for the classroom. Because I think one way in which you can open yourself to new thoughts or new ways of being and acting in the classroom, is just to try something different, try something new and see how students respond.

I don't think beliefs are things that we can just turn on and off or we can change, it feels to me like beliefs are very strongly linked to ways that we act, and so sometimes actually just trying a new action is one way to work on testing a belief.

NS: To add to that, Julia, you were saying you're linking dogmas to sort of religion and incontrovertible truths, and I think part of what we were trying to do is to show that these aren't just incontrovertible truths. That they actually came from somewhere and some person in some context and haven't always been that way. And I think maybe we're hoping that that would help teachers recognise that there are other options actually. It's not necessarily just about changing beliefs. But also recognising that these assumptions come from somewhere and that there are alternatives to them.

JT: In the book you talk about Euclid. That was new to me. I found it really interesting: the history, really, of maths teaching and learning and where it's come from. You also look at some other approaches that, had they been taken, maths teaching and learning would be very different to possibly how it is today.

So, the first dogma in your book is 'maths is a building-block subject'. So, Alf, can you just outline for us what that dogma is and why you think it might not be wholly true or there might be an element of misconception to that?

AC: So, I suppose there are a couple of ways in which I think we observe this dogma in action or in which you might be able to notice it within yourself.

I notice it in myself sometimes as well. I suppose that any time where you catch yourself thinking, in order to learn this bit of the subject there are all these other bits that have to be in place first before I can possibly teach the next step. Perhaps the idea that, because this student has not understood this bit of the curriculum, I'm not going to possibly be able to teach them something that's more complex. Perhaps, more broadly, that maths needs to have strong foundations. That would be another metaphor that seems to be often used that I would link with this idea of maths as a building-block subject: you need strong foundations; you need to know the basics before you can move on. I think there are a few issues and consequences of this view that lead us to want to question it. And some are the way that it can quite quickly lead to students for whom maths is never going to be for them, which actually links to one of our later dogmas, that there are students who potentially get a much less rich mathematical diet because it's perceived that they don't know some things that they can't be offered this sort of rich step.

And I think we know, in all sorts of spheres of life, that actually, as humans, we thrive on complexity. I think we'll probably talk more than once about the image of learning your first language. It's unfathomable almost, the complexity with which very young children are faced to learn their first language, and they seem to thrive in that context: noticing patterns and picking up rules and regularities. Just to add one brief sort of study, we at the University of Bristol had a seminar from Jon Star, a professor at Harvard. He was talking about a psychological study that had suggested that if you show students two different methods for doing a solution and get them to discuss two different methods, they actually learn both methods better than if you teach them one and then teach them the next one.

So that would also speak to me against this building block. That it's not that I sort of need to do one and master that and then do the next and master that but actually, sometimes, looking at things together can make it easier to learn both.

JT: That's an interesting idea. So, I suppose, in primary mathematics, sometimes when children are learning how to do multiplication, they'll do the grid method, and then they'll go on to the written algorithm. Whereas they might, if they were presented with both of them at the same time, be able to make those connections, which makes perfect sense when you have it pointed out to you. That's really interesting.

AC: Just to add on to that, I mean, I think another thing is looking at multiplication and division together as far as possible, because mathematically, they're the same process, really. I mean, they're inverses. So again, there seems to me a case for putting inverse processes together, learning them together. So it might help make sense of both.

JT: A lot of what you've said really resonates with the idea of mastery but, in terms of mastery and the idea of maths not being a building block subject, I think it [mastery] can often talk about curriculum coherence as being like a series of small steps of learning, and I was interested to know how you think that does relate to your first chapter in the book, in terms of maths *not* being a building-block subject.

AC: I certainly think that the idea of curriculum coherence is really, really important and, also, I think I've never seen the NCETM's ideas of small steps as meaning we've got to go from simple to complex. The building-block idea is trying to get away from this idea you have to move simple to complex.

If I give you a couple of examples from the NCETM materials. So, they suggest, for instance, in the professional development resources, that before you learn the numbers 11 to 19, you work on the numbers 20 to 99. Now that seems to be a disruption of the building-block idea, that we learn one to nine and then we go to this more complex sets of numbers you leave out 11 to 19.

And, of course, the reason is that 20 to 99 are named in a much more regular way. So, by doing that, we can work with students to develop a much stronger sense of number structure and then move into the teen numbers. And actually, the NCETM also suggests working with a dual naming of numbers.

So, as well as 11, 12, or 13 that they could also be named 1-10-1 or 1-10-2, 1-10-3. And again, that's adding in a complexity that is potentially going to actually simplify the situation for students, which sounds a bit paradoxical.

I'm delighted to see the Gattegno tens chart present through a lot of the NCETM materials. I don't know if listeners will know what that means, perhaps look that up if you don't, but it's there very strongly in the NCETM work. And again, that's a chart that offers awareness of, I won't say the whole of number structure, but you've got a lot of number structure there.

And depending on what numbers are exposed, sometimes up to hundreds of thousands, not necessarily to be looked at explicitly, but there with children in the first years of primary school. I think one of the things that the NCETM has really helpfully done, through the ideas of curriculum coherence and so on, is really point teachers to the complexities and subtleties of mathematics.

I think it is familiar to everybody now that division can be grouping OR sharing. Whereas, I think going back 15 or 20 years, there were probably times where it was quite unhelpfully mixed. You know what form of division we were talking about? Because it was all kind of the same. Once you've understood it all, it all seems the same and you got the same symbol for it. And then leads to a great deal of confusion. Getting clarity about that, and that's the sort of coherence, I think, is really, really essential work to do. What I think it doesn't then mean is that there's always this simple to complex move through the curriculum.

JT: Okay, so if we can come on to the next dogma, which is maths is always right or wrong. So, I really struggled with maths as a child and I failed my GCSE twice. I think I'm the only person at the NCETM who had to re-sit it and finally did it! And I think it was that immense pressure that children can feel, the fear of getting it wrong, the fear that you're going to be thought of as being inferior to your peers. So, there's a lot emotionally going on with children when they're doing maths sometimes, in a way that for some reason isn't there with other subjects.

But, for some other people, they love the fact that there seems to be this universal truth about maths and it's almost reassuring. So, I am interested to know more about that dogma and why you think it might not be true.

NS: I'm glad you bring up the issue of anxiety, Julia, and how that's really an important part of many people's mathematical experiences. And we know from research and cognitive science that actually being anxious about something prevents you from being able to think. Literally. And so, we really need to do a lot of work to make sure that what we're doing in the math classroom is not causing anxiety and that we have other options.

And I think, coming back to this idea of mastery learning, that the idea that any concept is just one sort of fixed thing, that you can represent in a step, increases the anxiety for students, because they don't see that there are other things they can do and be successful at, or other routes to getting back to the same concept.

So, I think what we wanted to do, when we're writing about mathematics not always being about just being right or wrong, was two main things. One was to shift the emphasis from just focusing on ‘right’ or ‘wrong’.

So, it's not that we don't think that there are cases when sometimes there's a right answer and sometimes there's a wrong answer. But there's so much more to mathematics than that. You talk to most mathematicians and, you know, they're much more interested in what is the reasoning process? How do you explain things? How do you listen to other people who are reasoning? How do you pose problems? How do you notice mathematical aspects in your environment? So, all of these things that are just as important in mathematics which should be part of teaching and learning mathematics and not just the focus on right or wrong. So, reasoning can be more or less convincing to different people, and that's not being right or wrong, hey’re variations or a continuum.

So, in that chapter, we provide other ways of working in the classroom that don't always focus on right or wrong. So, one example is, instead of saying, what is 12 times 14, which I'm sure got your blood boiling already, Julia! And literally does stop thinking is: how would you think about doing twelve times fourteen? Which invites you to talk about your process, which is actually much more interesting than the product, which the calculator has been able to find for over 50 years now. And soon we'll have digital implants that will do it for us.

So, really, what we need to be focusing on is the reasoning and not the actual product. The other thing is that we wanted to show is how, in mathematics, every instance of what is taken to be right or wrong always depends on some kind of set of assumptions as well. And actually students sort of know this, though it's not very often explicitly shared with them, but as soon as they move from positive numbers, where they were told that you can't do three minus five into negative numbers where it's like: oh, okay, well, you can do that now. They've experienced that it can't be done to: oh yes, it can be done if we extend our number system.

The whole of elementary mathematics is about extending the number system and, you know, famously when people finally get to high school, they get to find out about imaginary numbers. But instead of seeing it as this revelation of - oh, we're gonna change the rules now - it gets experienced in a very different way.

So that was one thing that we wanted to really bring to the fore, because it also is important outside of mathematics too, is that knowing that truths are always situated within certain contingencies. And we want to encourage teachers to make those sort of contingencies more visible for students, so that they could understand not only that they're there, but that they can be changed.

That that's part of what's fun about mathematics and saying: okay, well, what if instead of drawing a triangle on a flat piece of paper, I draw it on a sphere? What new, crazy objects do I get there? And that's perhaps some of the most fun and creative parts of mathematics.

JT: And that brings us to the end of Part one. I really hope we've left you wanting more because our second part will be with you soon, where we unpick Alf and Nathalie's next three dogmas: maths is culture-free, maths is for some people and not for others, and maths is hard because it's abstract. Do come back to join us for Part two.

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