The NCETM Podcast Episode 75

Maths Anxiety

Hello and welcome to another new episode of the NCETM Podcast, where we talk about all things maths. I'm your host today, Rebecca Longworth [RL] from the NCETM Communications Team. Joining me today is Sue Johnston-Wilder [SJW], an Associate Professor of Mathematics Education at the University of Warwick. She is here to talk to us about an important topic which may have impacted you when you were learning maths at school, or, if you are a teacher, you may see the impact of it in the pupils that you teach. The topic we're going to dive into today is anxiety in maths. I want to find out about the relevance of this at different phases of education, how it impacts teachers and learners, and if there's anything we can do to tackle the symptoms of maths anxiety in our classrooms. So welcome to the podcast, Sue.

SJW: Good morning, Rebecca.

RL: Good morning, it's really great to see you. First of all, it would be great if you could introduce yourself.

SJW: I'm Sue. I'm a former maths teacher. I moved into curriculum development and working with teachers, teacher development, and then I started to realise that just making maths more interesting and exciting wasn't enough. We tried history of maths, ICT, but there are certain groups of youngsters, or learners because they're not all young, that we weren't reaching.

It coincided with my personal circumstances that I became an expert by experience in things mental health. So what I started to develop, and fortunately I have a wonderful colleague, called Claire Lee, who was working at Warwick at the time, and we started to work on the affective domain. We recognised that we needed some people outside the maths classroom to help with the problem, and we recruited a group of lovely adults who said that they would be happy to be maths angels. They said in order to be able to help with the maths, they needed more maths themselves. So we got a group round the table and in the middle of the first session we used a number bigger than three as a power, and one of the teachers burst into tears. And we realised that we had a lot of work to do, training adults to be able to overcome their own maths anxiety, and we also started working on building what we call resilience.

RL: You can tell that you're so passionate about it, it even comes into your introduction of yourself, how it's influenced you as a person, let alone just the work that you do. So, you mentioned something, ‘maths angels’, could you just explain that a little bit more?

SJW: The idea we had at the time, and this was way back in 2009, was that the children, the learners in school, we were working in school at the time, needed safe spaces to ask questions that they thought were stupid questions, and that they wouldn't be humiliated by those. We've come a long way since then in terms of articulating our framework, but even then, the idea of psychological safety was quite key to our thinking. We didn't call it that because that one’s only come onto our radar more recently. But it feels very important and descriptive of what we're trying to achieve, that people who have been left behind or had adverse experiences, or even sometimes traumatic experiences, need that safe space to trust somebody with whom they can then explore more about what they've understood and what the problem is.

So it turns out what we were trying to create was coaches in fact, but we didn't know that at the time. Since then we've developed a lot of understanding about the role of coaches and the role of creating safe spaces.

RL: What’s the most significant thing that you've learned on your journey to finding out more about anxiety within maths?

SJW: Oh wow, that's a good question. The most significant thing that I have learned, is a real eye-opener. We know that we panic if there's a tiger in the room. We know that our brain is set to protect us. What I, and perhaps some of the rest of us hadn't realised, was that the brain is just as averse to social threats as it is to physical threats. So if you experience anything that the brain would experience as threatening your well-being, it

remembers that and stores it as dangerous, basically, and that was a real eye-opener. We've gone on to work on that further, but that definitely is most significant.

RL: That's interesting. Thank you for sharing that with us, Sue. Now in relation to that, I wonder if you could share the 'hand model of the brain' with us. I've heard you talk about it before, and I think it would really benefit other teachers if they heard about it too.

SJW: We need to understand what's going on when things go wrong. So, we're not psychologists, we're educators, and I want to really make that point quite strongly. We have a lot of debates with maths teachers about whether it's their job or somebody else's to work on this, but I think with four simple tools, we can do just enough psychoeducation to help our learners recover from anything bad that's happened in their lessons, or their experience of mathematics at home or anywhere, and come back and flourish in our lessons.

So the first tool that you've just asked me to explain is Dan Siegel's hand model of the brain. When you've watched me do this, it's good to watch the guy himself because he's the neuroscientist, we're the educators, and there's a video we can put up on the link to him explaining the model. So, if you imagine that your two hands represent your brain, and if you look at the brain when it's thinking, and calm and at rest, or puzzling over some problems, it's quite well connected, if you see how tightly your fist and all the bits touch each other. If you imagine the front fingernails representing the prefrontal cortex, which is the part of the brain where you do difficult things, like maths and semantics and learning new languages the hard way, as opposed to when you're a baby – and then the cortex represents the rest of your hand. And then if you open up the brain, the thumb tucked in represents that part of the brain that does the fight-or-flight, it's called the amygdala, but we don't need to know the technical terms, we just need to know this is a really good model. And what happens is, if you're terrified of something like a tiger coming into the room, is that effectively, the thinking part of your brain goes offline, and the part that controls the physiology pumps your body ready to fight or flight. So you get an increased heart rate, you start feeling a bit sick because the resources are leaving your stomach, because your stomach is not needed at that point, and you might feel sweaty palms.

If people think about a time when they've been frightened, they'll recognise the physiological symptoms, but you cannot think mathematically because that's not what your body's trying to do - your body's trying to pump you for saving your life. And so if anybody tries to talk to you when you're in that state, you basically can't hear it because it's like an alarm going off in your head. You have to learn the relaxation response, which is written about by Herbert Benson, to put your brain back together in those situations if there is no real threat, or you have to protect yourself, like leaving the room. That is a very powerful hand model of the brain, and the way that we use it in our work, is that if you're trying to teach somebody some mathematics, if they do that [Sue opens her hand], it means please stop talking, I'm panicking, and I need to calm down. A lot of people think they're stupid at maths and the key message with this tool is you're not stupid, you're panicking. If you calm down, you'll be able to do the mathematics, but you need to be in a safe-enough space, or have otherwise triggered your relaxation response, to get back to that place where your maths can be reconnected with your brain, and you can actually think clearly. For me that's a really important, liberating message for anybody who feels stupid at mathematics.

RL: Yeah, it's that confirmation that you're not stupid, you're just panicking. I really think that's a powerful thing to say, because as a teacher myself, in the past, I can picture children who have panicked within maths lessons. You need to kind of bring them back down to where they feel safe, where they feel respected, where they feel calm enough to be able to see the numbers and the maths, because otherwise you can't see past that. It's just the way that we all are built - that's really helpful.

SJW: Absolutely, there's nothing wrong with you. It's a perfectly normal reaction to perceive threat, and you say how, as a maths teacher you've already observed this phenomenon, you knew what to do. What we're doing with the hand model of the brain is sharing it with our learners and their parents and their adults around them, and not just keeping it in our own knowledge, but giving us a tool to explain it to the others. Because when you start working with children who are anxious, you have to recognise you're also dealing with anxious staff, anxious parents, all around these young people. A lot of the teaching-support staff have had bad prior experiences. As you just said, there's nothing wrong with you, so if I see anybody who, if I say I'm a maths teacher and they do that (put their hands up), I say 'what happened to you?' not 'what's wrong with you?'. And

that's from trauma-informed literature, that behind that need to protect themselves from the word ‘maths’ is an experience that I need to know about.

RL: Yeah, that's really interesting. So you say that there'll be a lot of people around that child who are maybe struggling with the impact of anxiety and maths anxiety themselves. So how prevalent is it in all age groups? Is it something that children from as young as the first year of primary school, up to adults… is it something that impacts everybody?

SJW: Not everybody. Some people thrive with the way we’ve historically taught mathematics. It's like a human being spectrum: on one end, there are the people who start out building their logic system in their brain earlier, at the other end, there's people who start out building their empathy system earlier. And, as we know from Carl Jung, these systems can both be developed over time, but you need maturation to develop the second one - you need time. The danger is that you put people in boxes from a quite young age, and you say ‘you’re mathematical’, ‘you're the English one’, the whole of logical and empathetic experiences are part of the human being spectrum, and we should be entitling all learners to learn logic and empathy.

What happens early on is the children who are more empathetic naturally, which tends to be girls, but it's not all girls, it's mostly girls and some boys, they tend to need more of a narrative around the maths and more sense of why it's important and more sense of it being fun and something to share and to work collaboratively. Not lots of symbols early on, but lots of apparatus, and being able to scaffold any maths experience with apparatus, with story. And then the ones who are naturally more logical, if you like, more systemising in Baron Cohen's words, would be the ones who will naturally pick up the way it was traditionally taught and wouldn't be distressed by it, but might be more distressed by working in groups or something like that, where they haven't developed their social skills and their sense of reading people yet.

So if we think of everybody as lifelong learners, you can imagine that in an education system where you just grow everything, a growth mindset, these children don't get put in boxes, but in reality currently, I would say that based on one sample survey, the level of anxiety in Year 7 is about a quarter high and a quarter significant - that is a large population of our learners. And we don't know enough about exactly when it develops, but we do know, narratively, that there are children, aged six, who burst into tears in a maths lesson, and we do know that by the time they're eight and nine years old, a sixth of the parents are struggling to support them with the maths homework.

What that tells you is that there's an awful lot going on laying the primary school foundations, and there's been a lot of work done on primary maths over the years and we're trying, but there's still the possibility of getting adverse experiences even in primary, and you don't know whether they're coming from home or school, but what we do know is that maths anxiety is contagious, and we’ve known since the 70s that an awful lot of elementary school teachers and primary school teachers have maths anxiety, and so the more empathetic learners will pick it up from their teachers and learn that maths is something to be frightened of.

If you want a number, then by the time you get to adulthood, I would say one in three adults has maths anxiety serious enough to interfere with them doing maths, and that they need to learn how to address it before they can do all the things that maths brings - like a job. In my current role, I meet a lot of people in middle age, or maybe younger, who wanted to be a nurse or teacher or a doctor when they were 18, but couldn't face the maths. And so we lose those people from those professions, that we actually want and need, by not tackling the impact of their prior experiences. In other countries, it's higher: I’m working with Brazilians at the moment and they reckon their estimate is 45 to 50% of the population. The problem with giving you numbers is that maths anxiety is a spectrum, and it doesn't really lend itself to giving you a percentage, but if we go for one in three, that really highlights to teachers and to adults and to anybody in lifelong learning that there is a big problem here.

RL: Yes, that is a massive amount, isn't it? If you think about the people like you said haven't been able to apply for jobs or didn't have the confidence to, because of the maths, and how that has a knock-on effect with their children, and like you say, if it's contagious, how that can impact the children at home and then coming into school. So if there are teachers listening now, primary teachers, secondary teachers, teachers in post-16 settings, what signs should they be looking out for in their pupils?

SJW: In FE, what the students present is avoidance: the learners will not come to maths lessons, and they won't come, in higher education, to the maths support centre. They need to believe that they'll be safe if they have another go at maths. So their body and brain are protecting themselves from further harm in the best way that they can, and so attendance in FE is very poor, so avoidance is the first symptom I would be looking for.

The second one is youngsters who are more shirty than they would be in any other lesson - more aggressive, if you like. An extreme case is somebody who was on one of our courses, and we hadn't yet finished the process of building their maths resilience, and she threw a chair. She was so cross at having to do more maths, and she was faced with a problem - she didn't know how to do it, so she short-circuited into panic mode.

There are others who aren't so shirty and will avoid by being helpless. Teachers will be able to recognise the youngster who says 'I can't do it', and you've only asked them to draw a picture of a triangle. Or you've asked them to do something that we perceive as simple, but it's not simple if you're panicking, so that sense of a learner being helpless or paralysed with fear, still not doing something that you know they know how to do, or just totally avoiding, those are the typical things that you would see. Passivity or aggression - fight, flight or freeze, in other words.

And then it goes beyond that, because there are youngsters who you know perfectly capable, but they don't do well in tests and they don't score what they wanted to score because there's 'classroom anxiety', if you like, but there's also 'test anxiety', and they're two parts of the story, so any youngster who is not progressing as you would hope them to, or they're not doing as well in maths as in any other subject, those are signs that there might be an underlying problem.

RL: So what other tips would you give to teachers or practitioners who want to help a youngster - or themselves - with maths anxiety and resilience within that?

SJW: We've shown the hand model of the brain, we've talked about the relaxation response. A lot of professionals who work in anxiety, psychologists and therapists, will teach the client relaxation strategies, and there are some that we can use in the classroom So because they're not therapeutic, because they're teacher strategies - I call them 'micro-mindfulness' -things you can use in the classroom.

Two of those are examples, one is 'five-seven' breathing, or 'square' breathing. If you're in a panic state - and in South Africa we've got teachers using this strategy, they have classes of sixty - and they'll say 'OK, how's everybody feeling?', and if anybody puts up their hand like that, then they spend a moment calming down and they breathe in for five and out for seven, maybe four or five times, and your heart rate goes down. 'Now, what's the problem? Let's talk about the thing that triggered you. What is it you need to know?' and that kind of thinking. So that's the first and second tools.

The third tool is a circle diagram. If you imagine drawing a doughnut on a piece of paper, inside the empty space I could colour green, the doughnut I could colour orange, like all good doughnuts, and the outside you could colour red. And what we're saying to the learners is, you could stay in the green zone, your comfort zone, we all know about our comfort zone. When you step out of your comfort zone, you might be stepping into the doughnut, into the brave space, or you might be stepping out too far into your threat space. And you have to be able to decide, when your heart rate goes up, is this a challenge or is it too far, and it's a threat? What the brain does naturally, is that it appraises the situation and says, 'OK, the heart rate's gone up, is this something I need a bit more energy for, because it's a challenge, or is it something that's outside my capabilities and it's a threat?'. So working with the youngsters to distinguish when they're in 'challenge' and when they're in 'threat', those are the really important conversations to have, because you can reframe your thinking as excitement - if your heart rate's gone up, and OK, this is challenging, what resources do you need? What is there available to support you?

Some teachers already lnew strategies like this like 'brain, body, book, boss' or 'see three before me'. This idea of building, not a dependence on teacher, but the idea that there's NCETM resources, there's Khan Academy on the internet, and a lot of youngsters are discovering these resources on internet, so they're not totally dependent on the teacher, but also being able to reach out to peers for support. A lot of maths teachers in the past haven't allowed conversation in lessons, but actually, being part of a learning group is part of what keeps you safe in that doughnut.

The fourth thing is a ladder model, which is based on Bruner's ideas of embodiment, iconic, symbolic, but it takes it further. So if you're feeling in your orange zone or your green zone, thinking ‘I can't do this’, ‘I don't understand’, then rather than saying ‘I don't understand’, you can say to the teacher ‘I need some more rungs’. It's not about you not having the ability to climb that ladder, it's about the teacher putting some more rungs in place, and that idea was developed when my daughter was learning to climb after she broke her back. And you just put all the rungs in, and then as they get more confident, the climber’s missed out some, because they don't need them. But if they can't reach, and they've got to develop the muscles to get from there to there, you don't say ‘I'll never do it’, you say ‘I need more muscles, but for now, can I have an extra rung, an extra step?’.

II think a lot of us know this from the notions of scaffolding, but we don't teach the learners that language of ‘I need another rung’, and so it ends up being, ‘I can't do this’ rather than ‘I need another rung’, so it's all language to empower the learner. We fundamentally know that learners want to learn if they're feeling either safe or brave, but not if they're feeling threatened.

RL: I really like the powerful image of the doughnut and also the rungs on the ladder as well -hat that makes so much sense, doesn't it? And also, a lot of what you're saying is giving the language tools to the learner, for them to explain what is going on within themselves and how they're feeling. Like you say, a lot of teachers do know about scaffolding and things like that, but we are gatekeeping that information and not sharing it with the learners, and that maybe is where we can make improvements.

So where would people go, teachers who are listening to the podcast, where will they go to find out more about these tools and more about maths anxiety and resilience, as a final thought?

SJW: If they’re really keen, we can put some links up to two or three papers, intended to be accessible to practitioners. And there are quite a lot of videos that we can link. In a year’s time there'll be the Mathematical Resilience book, we're handing it over to the publishers in September. We've also set up the Mathematical Resilience Network in the UK, but also in countries around the world, because other countries want to use these tools because they also have the problem. So we've launched in Ireland and Brazil and South Africa, and there's a small group working in Turkey, and they're planning to build these simple tools into a strategy that all maths teachers can be expected to know about.

But if you look at the Trauma Informed Handbook, the strategy globally, or even nationally, is to have three levels of awareness:

One, that everybody knows how to spot anxiety, knows that it exists, knows the sort of symptoms, the sorts of things we covered in first part of this. Everybody involved in any kind of learning, that includes the school administrators, so they don't say ‘what's the matter with you?’, they say ‘what's happened to you? Who can we get to help?’.

Then you have an internal level of knowledge at level 2, which is people who know and can use something like these four tools for psychoeducation, the processes of building safe spaces, and one of the ways that we might do that is building more courses for teachers or more aware adults that we will call coaches. And what's exciting about this is that the ETF, which runs the FE programme for teacher development, has said that all resit students should have access to a coach. So what we now need to do is train the coaches, but in some colleges they’ve started that under the previous funding.

Then you need a third level of expertise, which is outside the institution, where you refer the really bad cases. We don't know how many people are those really bad cases, but if I say that I've only met two people in the last ten years that I couldn't help, and that they needed specialist therapy, that gives you some idea, and I've worked with an awful lot of people. So we’re aware of what we call extreme maths anxiety, which is like a clinical phobia, if you will, and that obviously depends on having had something very, very bad happen to them. The problem is that a lot of people think ‘I can't do maths because it's difficult’ and ‘I haven't got the math gene’ and all those sorts of excuses that are built up over time because of the maths anxiety that was there. It's been written about since the fifties, so we’ve known about it, we just haven't taken it seriously enough. And now if Sunak wants 90% of the population to be numerate enough to do jobs involving data, and you've got 30% of the population with maths anxiety, those sums don't add up anymore, so you have to stop thinking about maths being elite and start thinking of it being something that is for everybody. I think we need to change the narrative

across the country. If somebody says ‘I can't do maths, I never could do maths, my mum can't do maths’, which happens quite often, you have to say, what happened to them and how can we get them back to developing that part of their personality?

I feel quite ambitious for this project, which is why we developed the Maths Resilience Network. Fortunately, there are awful lot of people with me on this who want to use these tools, try these tools out. And these people are all happy to support teachers with their action research, with noticing. We've got two papers we can share with teachers about how to get started. We've got tools to measure maths anxiety, that are accessible to teachers rather than psychologists, so you can see the impact and show the headteacher and the management that, actually, this is a thing and it's affecting a large number of our students.

RL: Wow, all the work you're doing is fantastic and there is a lot out there for teachers to of access. And yes, it would be great, we will add the links to those papers to the show notes of the podcast, and all the other things that you've mentioned that will be really useful to teachers listening.

So we've come to the end of the podcast. It's been fantastic speaking to you today Sue - thank you so much for taking time out of your busy schedule to come and chat to us.

SJW: I'm going to leave you with one powerful image, actually, if I may. It's an image from London of a bus having hit a cyclist, and the cyclist is stuck under the bus and is obviously distressed, very, very distressed, and you might think that's a hopeless situation until the experts get there. But what happens is one hundred Londoners are moved to go in together and lift the bus off the cyclist. And I think what that image does, is it empowers ordinary people to be part of the solution.

RL: Yes, that is a fantastic image. Thank you very much, Sue.

So to our audience, I hope you enjoyed the conversation today about maths anxiety and I hope you found the topic of conversation interesting and insightful, I know I learned a lot personally from Sue today. If you're interested in learning more about maths anxiety and what tools you can use in the classroom, all the relevant links will be in the show notes of the podcast.

We've got plenty more fascinating conversations for you to listen to on other episodes of our podcast, and we're always adding more, so keep your eye on our social media and thank you for listening. Until next time, goodbye.