The NCETM Maths Podcast 83

Problem-solving Schools

Hello and welcome to the NCETM Maths Podcast. I'm Julia Thomson [JT], Senior Communications and Marketing Manager at the NCETM. And in this episode, I talk to Liz Woodham [LW], Primary Coordinator at NRICH, about their Problem-solving Schools initiative. With 25 percent of all foundation tier and 30 percent of higher tier assessment in GCSE Mathematics consisting of reasoning and problem-solving content, and 66 percent of KS2 SAT papers consisting of reasoning questions, these skills are not just an essential part of a child's maths education, but they are also crucial to their academic success at school. So how do we ensure that we address this often challenging, but also really fun and rewarding aspect of maths for children?

In this episode, Liz tells me all about NRICH's new Problem-solving Schools initiative, which is suitable for schools from Reception to post-16. And she also shares one of the initiative's webinars, and rich tasks, with us to give us a bit of an insight into how it works and what schools who get involved can expect.

In this episode, you'll hear me mention RIWGs. These are Research and Innovation Work Groups run through the Maths Hubs Network. They're groups of teachers and experts at a local level who carry out action research in classrooms on a topic of interest or local need, such as SEND in mainstream settings, mixed-age classes and oracy. Many of the themes explored and researched end up informing the overall content of Maths Hubs' professional development. And in fact, the RIWGs I refer to have done just that. Becoming themes on fluency at KS3 and problem solving in the Teaching for Mastery Programme, available to all schools involved in the Sustaining phase.

I really hope you find our conversation thought provoking and useful.

JT: If you would just like to tell us a little bit about who you are and what you do.

Liz Woodham [LW]: Absolutely, Julia. Thank you. So, my name is Liz Woodham. I'm the Primary Coordinator at NRICH. My background is in primary teaching, but I've actually been at NRICH now for rather a long time. So, my responsibility is everything primary on the NRICH website so developing resources, activities, guidance for teachers and leading associated professional development where appropriate.

JT: Lovely. And can you just tell me a little bit more about NRICH?

LW: Absolutely. So NRICH believes in nurturing successful young mathematicians. And so, what we are offering are resources that help develop not only children's understanding and helping them use mathematical ideas fluently, but we're also trying to develop their problem-solving skills so that they can think in a mathematical way, reason mathematically, and also have a positive mathematical mindset.

So, we're hoping to nurture resilient and curious young mathematicians. On our website we produce resources that are completely free of charge and accessible to help teachers develop mathematicians in the classroom.

JT: That's fantastic. NRICH has been around for a very long time, haven't they?

LW: Yes, you're absolutely right.. Originally it was very much a resource for particularly high-attaining children, but we have shifted, and we really believe that we're now offering resources for all children to be able to think mathematically and become young mathematicians.

JT: I've spoken to you in the past about maths games and that was a brilliant conversation, and I recommend that our listeners go and listen to that. We talk a lot more in that particular episode about NRICH's background and its mission . But I'm here to talk to you today about your Problem-solving Schools initiative. So, would you like to tell me a little bit more about your rationale for setting up the Problem-solving Schools initiative?

LW: We wanted to give schools an opportunity to raise the profile of mathematical problem solving - this is why we set up the initiative. We're doing that by offering a framework, what we're calling our Problem-solving Schools Charter, so in a primary school, we might be talking about the maths subject leader chatting with all staff in a secondary school, we might be talking about the maths department, but to allow teachers in schools to reflect on their current practice in terms of problem-solving and then to identify some areas where they think they might want to improve and then they'd log those areas with us.

And it's about giving them the opportunity to have this focus on problem-solving in mathematics and offering support as they do that to improve their practice.

JT: Why is mathematical problem-solving an important skill to develop?

LW: It's a really good question. At NRICH, we believe that problem-solving is at the heart of mathematics. Mathematics is nothing without problem-solving. To help answer your question, I'd like to talk a little bit about the framework that we use at NRICH as we're creating our resources: many listeners will have heard us talk about this already.

But we use a model that was proposed by Kilpatrick and colleagues in the United States. And they developed what we call a ‘Rope Model’ which includes five strands, where each of these five strands are equally important characteristics of a mathematician. One is about a mathematician having good conceptual understanding which I think we all recognise as important in mathematics.

One of them is about mathematicians having procedural fluency. Now I think that's quite an interesting one in itself because what we might immediately think about as fluency could be something like how quickly can I remember my tables. Often people associate fluency with speed, but I would argue in the Kilpatrick paper and work that we've read beyond would suggest that there's a lot more to fluency than just speed.

And beyond even the manipulation of facts, we can apply, we can think about fluency as being about flexibility, for example. It could be flexibility with number, but it could be flexibility

in approaching a problem using different strategies. So, that's all the fluency aspect of being a mathematician.

So that's two aspects. The other three parts of the Rope Model that Kilpatrick talks about are perhaps strands that we're not so used to discussing in school maths. One of them Kilpatrick and his colleagues term a ‘productive disposition’. At NRICH, we think about that as a mathematical mindset. So, do I value mathematics? Do I think it's worthwhile subject to pursue? Can I get better at mathematics by working hard? That kind of links with Dweck's growth mindset.

So that's the third strand. The other two strands, one is called adaptive reasoning, and the other one is called strategic thinking. At NRICH, to help teachers think about those in more detail, we've termed strategic thinking 'developing mathematical thinking skills', and we've broken those down into five.

So, these are the kind of processes you might go through as you solve a problem. So key things like exploring, working systematically, going on to conjecture and generalise. And then visualising and representing, followed by the fifth element of reasoning and explaining and even proof.

That final part links with the Kilpatrick model in adaptive reasoning. So, it's a very long-winded way of answering your question, Julia, but problem solving is absolutely key to mathematics. At NRICH, we think about these five strands, if you like, all of them being equally important to nurture strong mathematicians.

JT: That's really interesting. And I was reflecting when you were describing them, how much they resonate with the Five Big Ideas in Teaching forof Mastery.

So, we look at things like representation and structure - that's obviously the ability to visualise your problem, to see the structure of the maths.

There's mathematical thinking as well in there, in terms of being able to reason and conjecture and talk and discuss your methods. And I think when you were talking about fluency, which is another one of the Five Big Ideas, it’s one of the things that our Research and Innovation Work Groups have been looking at - fluency at KS3.

They've talked about how important it is to define fluency accurately because there is this perception that it is about rote learning. It's about memorisation of times-table facts or memorisation of particular kinds of methods - really, it’s about flexibility.

Something that I've seen in some of the work we've been doing in our Research and Innovation Work Groups on problem-solving is having a playful approach to mathematics and not necessarily thinking there has to be one method, or one solution pathway, but there can be multiple solution pathways.

Children can be flexible with that, and also they can be playful with the maths, and another thing is how important it is for teachers not to think that they have to lead pupils to the correct answer, that it's perfectly fine for teachers not to know the answer themselves and to model that being playful, not knowing the answer, that sort of thing.

Going on to the practicalities of problem-solving schools, what's involved in problem-solving schools? I know there's a framework that schools can use to look at their existing context and monitor their journey. Can you tell me a little bit more about that?

LW: That's right. The framework we've called our Problem-solving Schools Charter, nd when a school is interested in signing up to become a problem-solving school, we share the charter with them. Anybody can look at the charter, it's on our website.

What we've done is to create some statements about mathematics in schools, and we've grouped them under five headings. So, we've got vision and ethos, leadership and professional development, curriculum, pedagogy and assessment. Classroom culture and problem-solving beyond the classroom.

There isn't a huge number, about five statements in each section. The idea is that schools think about each of the statements and reflect on where they think they are currently in relation to that statement. And then they self-assess, offering a sort of ' RAG rating'.

It's definitely not the case that to be a problem-solving school, you need to have given yourselves greens everywhere, bsolutely not. The process of signing up for a problem-solving school is thinking about where your practice is currently.

Once you've done that RAG rating, we invite you to identify three goals, three objectives that you particularly want to work on. Then the idea is, is over the course of the next few terms, you'd think about how you could develop the practice in those three areas. And then we give you a chance to rate yourself again to see whether you feel you have made progress.

We are offering resources to support schools: each half term we're focusing on a particular aspect, and so far we've offered some resources about working collaboratively.

What we're doing now is we're working each half term through those five phases of mathematical thinking. So, we began with exploring and noticing, and then we then moved on to working systematically in the following half term, and this half term we have just released some resources related to conjecturing and generalising.

By resources, we offer first of all a webinar completely free to sign up to, one for primary practitioners and one for secondary where we would chat through some of the ideas we think are important, and we would look at some tasks that we feel lend themselves to that particular focus.

In our problem-solving school section on our website, go to resources and professional development, and you will see that we've now uploaded recordings of those webinars along with some written guidance and collections of NRICH tasks that we feel will help you develop people's skills in that particular area.

In terms of the guidance, we're not offering quick-fix solutions. We're offering things that in schools you might like to think about if you're wanting to support students in this area. So, for example, let's take the case of exploring and generalising. The way we structured that guidance was that we thought first of all about some of our beliefs around mathematics, how that would then inform the general way of working in your school in terms of giving children opportunities to explore and notice mathematically.

Then some things to think about in terms of: he nitty-gritty in the classroom, the kind of interactions you might want to be having, the kinds of tasks that will lend themselves to giving students these opportunities. So, a lot of our guidance has that sort of similar structure.

JT: I was thinking about this as a kind of a school-wide initiative, and it's interesting that you mentioned that it's for primary and secondary schools.

LW: That's right.

JT: Something important to point out. Also, I think we're all as practitioners conscious that children have a mathematical journey, and they can be a bit disjointed sometimes between phases, particularly between primary and secondary school. So, it's nice perhaps to think - and maybe this is something for maths leads at MATs to consider - how the children in their schools as a whole, their problem-solving journey can take place from Early Years and Key Stage 1 right the way up to post-16.

One of the things I was reflecting on as well, when we're looking at school-wide initiatives, is that they can be quite onerous sometimes. I'm thinking of one in particular that my school got involved with once: it just created a tonne of work, and I think that's something that you've been really conscious of when you've been designing this.

LW: We wanted to make our Problem-solving Schools Initiative attractive because schools would like to find a way to help them raise the profile of problem-solving. We didn't want to be forcing something on schools: we wanted it to be something that we hoped schools would be really keen to sign up with to develop their own practice.

And you're right, this is not about schools having lots of monitoring visits every two weeks. Absolutely not - it's light touch in that sense. The assessment is all self-assessment done by schools, by practitioners in schools.

It's really about helping teachers and schools develop their problem-solving practice, with us offering support that they can dip in and out of as needed.

JT: It's important, I think, to remember that teachers are professionals and we're altruistic, so we can be trusted to implement things in our schools and don't necessarily need lots of monitoring or that sort of thing.

Another thing I wanted to ask you about is Research and Innovation Work Groups and I'm conscious that I haven't explained what they are. A Research and Innovation Work Group is a small group of schools that work with their local Maths Hub on something that's of relevance in their local area, something that they want to do some action research on to find out more about.

I've been looking at some of the teacher feedback and some of the findings, and it's really interesting, reflecting on what we're talking about today: one of the things that one of our groups in West Yorkshire Maths Hub noticed was that teachers see a difference between NRICH-style problems and SATs-style problems.

I wanted to delve into that a little bit with you: can you tell me what your initial thoughts are about that?

LW: Iit all hinges on how you define a problem, really. At NRICH, we would say that a problem is a task that you don't have a ready-made way of solving.

So, when you've read through the problem, it is not immediately obvious how to go about solving it. Now, of course that is complicated because I could look at a task and regard it as a problem for me, whereas you could look at that very same task and it wouldn't be a problem for you, just because of your different experience and your different knowledge and understanding.

So we have to bear that in mind that a single problem is not necessarily a problem for everybody. The SATs-style questions, many of them would not be immediately obvious to the vast majority of children how to solve them, and there's some reasoning to be done in order to begin to have a go at that task. And perhaps it could be solved in a number of different ways.

I think that sometimes, in classrooms, we offer a style of question, which we then give students a way of solving, so we might demonstrate a way of solving it. And then immediately we're offering students identical examples, just with perhaps different contexts or different numbers.

I would say then that the students are not problem solving because they are not really thinking about how they're going to solve it. They've been given the method and they're applying it. Now, I'm not saying that it's not useful to have conversations about efficient ways of solving some of these tasks, but I wouldn't see that as rich mathematical problem-solving.

I think students often really benefit from watching and listening to the adult, the teacher, the practitioner, modelling that kind of messy process for them. So, if teachers can put themselves in a position of of looking at a task which they genuinely have not seen before - something genuinely that you've not looked at before where is not immediately the solution is not immediately obvious. And then if you model that kind of thinking process, you involve the children in a collaborative, problem-solving effort, I think that's a really powerful message to send children, that if we don't know how to solve something straight away, this is not negative, this is a really important learning opportunity.

I am going to have some strategies, some skills, some things I can bring to the situation, but if we do that in a collaborative way in the classroom, I think it makes it slightly less anxiety-inducing for everybody.

JT: Absolutely, and that comes back to one of your Kilpatrick strands doesn't it? That creating that productive disposition, creating that growth mindset almost, that there's nothing wrong with not knowing the answer That's a normal part of mathematics, and I think that can be quite a profound thing for children to realise sometimes, because they're so often, all the way through school, presented with these problems that have an answer that they have to find, and that's sometimes where that anxiety can come in.

Whereas if, as part of our normal classroom practice, we’re looking at problems where we don't know the answer, we're all having to use reasoning skills, have discussions, think

about different solutions, perhaps different tools we might have in our mathematical toolkit to approach it, then it becomes much more normalised, I think, that it's perfectly acceptable not to know the answer.

And one of the things that I was listening to some Maths Hub Leads talk about recently, was one of the changes in maths over the last few years, and I think it's a really positive change - and hopefully it will become more widespread - is less of a focus on the solution, and more of a focus on the problem, the structure, the method, which is, after all, so much more interesting than just an answer with the tick next to it.

So another question, Liz, because schools are really, really busy places, and I think that we talked about this in our last conversation on maths games: sometimes problem-solving can be seen as a bit of an add-on that we focus our maths lessons on developing procedural and conceptual fluency and we don't always necessarily get on to that problem-solving or we'll see it as an add-on. Something that we'll do sort of separately if we have time.

I'm interested to know if you've spoken to schools that you're working with to inform what you're doing. Have you any ideas or any kind of feedback from schools on how they're going to make time for this in their curriculum?

LW: It's a really good question. You're right:e have a teacher panel that we've been meeting with roughly termly. It's an opportunity for us to seek views of practising teachers about NRICH resources about the Problem-solving Schools Initiative more generally, and it's a chance for those teachers to not only share their views about how they use NRICH, but also offer suggestions of things we might do differently.

We can also offer them some of our emerging ideas and new thinking and think about their response. It's a really useful forum for us, in terms of how the teachers we've been working with have been, as you say, making time for problem-solving. It happens in different ways, but I think one of the things which is possibly common amongst many teachers is this idea of sort of embedding rich tasks within the planning framework.

However a school records the planning and the schemes of work they will make specific links to NRICH tasks, of course, they don't have to be NRICH tasks, but rich mathematical tasks, so that these are central to the resources used by teachers in the classroom. Now, we're not, of course, saying that every single maths activity has got to be a rich task, but I think unless you plan in those opportunities, you're right, that it can be difficult to make time.

And I think one of the things that I'd really like to emphasise is that all the tasks that we are offering in our linked tasks in the Problem-Solving Schools Resources section on our website, are not just good for helping students become better mathematicians and better problem solvers, but they are also all curriculum-linked.

You can be assured that if you're choosing one of those tasks that offer opportunities to, let's say, explore and notice, you can be reassured that actually there will be a curriculum link in that task too.

It's not like you're adding something on which is totally irrelevant in terms of the mathematics you are working on: we have made very sure that our tasks that we're gathering together do link to curriculum objectives - I think that's a really important point to make.

I think the final point I would make is that I fully accept that not every child is going to love mathematics and want to continue studying mathematics beyond 16 and further.

However, I really want them to be basing their decision on a true experience of mathematics: what does it mean to work mathematically? And unless we offer children opportunities to work on mathematical problem-solving and rich tasks, I believe we're doing them a disservice. We are not offering them mathematics: we are offering them a limited diet of mathematics, and I think that's not fair.

JT: One of the questions that I see coming up a lot, and I wondered you have any opinions on this, is about what the difference is between problem-solving and reasoning?

LW: Excellent question. I think reasoning is integral to problem-solving. When we think about developing mathematical thinking on the website, the five phases that you go through when you solve a problem, we do focus particularly on reasoning in that fifth stage.

The reason we have a particular focus there is we're at that point where , we've come to the parts of the problem where we might have found solutions and what we're doing is offering some explanation about how we know we've got a correct solution. But actually, it's more than that.

It's can we convince somebody else that our solution is valid? And maybe we can go into some proof, and by proof, I don't necessarily mean algebraic at all. I mean a watertight argument: it could be pictorial - here are many lovely pictorial proofs which are very accessible for primary.

So, In answer to your question, at NRICH we very much see reasoning as part of that final phase in the problem-solving process. However, I think there's no getting away from the fact that when we are exploring and noticing, we're also doing a bit of reasoning in a kind of less formal sense of the word.

Perhaps this is not about proof at all, but this is about, ‘I've noticed this and this, I'm going to try this next’. Now that is a form of reasoning. It's a form of explanation. And I think in answer to your question is that I'd see reasoning as integral, formal reasoning in terms of convincing, and proof comes at the end of our phase, but we're doing these momentary little chunks of reasoning throughout the process.

I think in the classroom, we can give children lots of opportunities for those little bits of reasoning really frequently and quickly in a classroom setting in everyday maths lessons all the time. But if we're going to give them the true experience of being mathematical problem-solvers, we also need to plan some opportunities for them to do this more formally, convincing and proof.

JT: I suppose what you're saying there is that reasoning is intrinsically linked throughout the problem-solving process from the outset when we're exploring and noticing, when we're thinking about different kinds of approaches we might want to take, to that kind of mathematical thinking aspect of the problem where we're proving, disproving, we're conjecturing, we're generalising.

In primary schools, we're often thinking about how we teach these distinct things in our curriculum, but it's not necessarily helpful to try and separate all of these things out. They're part of a cohesive whole when we're looking at mathematics, they're embedded throughout all of the mathematics that we do in class.

LW: I think so. And I'm reminded that problem-solving and reasoning and fluency are the three aims of our national curriculum, aren't they? Often, we forget that actually these three themes should be pervasive throughout.
The national curriculum document offers a little bit of an explanation about how they view problem-solving and reasoning and fluency, but I think they're so linked that sometimes it's not helpful to try to split them up.

JT: So, would you like to tell me which webinar and task you you'd like to share with us today?

LW: Yes, of course. I mentioned that we're in the middle of a series of webinars illustrating these five areas of developing mathematical thinking and the first of which if you think about when you're faced with a new problem this idea of exploring the mathematics and, and thinking about what you notice, is exploring and noticing.

When we led the webinars about exploring and noticing, we talked a little bit about the guidance that we've written, but we wanted to give participants a flavour of what we meant. So, we had a go at a few tasks together. As I say, you can watch these recordings on the NRICH website, but let's give listeners a little flavour of that.

One of the tasks we had a go at in the primary webinar, was one which is called Make 37. I'll try and describe it: I'd like you to imagine that you've got a bag full of ones, a bag full of threes, a bag full of fives, and a bag full of sevens. And the challenge is to choose ten of those numbers.

Now you can choose as many as you like from a particular bag - you don't have to choose one from all, but all the bags. So, it really is free choice. But you've got ones, threes, fives, and sevens, and I'd like you to choose ten of them, which when added together make a total of 37. Now, if you've not seen this problem before, you might like to pause the podcast and just have a little play with that.

So in a classroom situation and in the webinar itself, we gave participants a chance to have a go. This involves a lot of messy mathematics – presumably webinar participants were scribbling a bit. In the classroom, you'd be expecting children to scribble - maybe they're working alongside a partner to work collaboratively.

Aafter a little bit of time, as the teacher, you might be walking around, listening in, looking over shoulders. What are the children doing? When I've done this task with children before, they just pull ten numbers out without thinking about it, find the total and go from there.

And that's brilliant, that's a really helpful way of starting the problem, just having a go. I think that's a really strong message we'd like to be giving children that you don’t worry in those initial stages. It will be messy. Just try something and it will offer you insight.

So, you've got ten numbers, you've added them together.

What have you found? Oh, well, maybe I haven't got 37 yet. I try again and I might do that. This is where we might talk about trial and improvement. I might see, how far off 37 am I? Can I tweak what I've done to get a bit closer? And I might be doing this with a partner. So after five minutes or so, the whole class would have come up with lots of examples.

And then we can chat. In the webinar, we said to the participants, what have you found? What have you tried? Has anybody got 37 yet? And nobody has got 37 yet using ten numbers. So, we work a little bit more and then we think, hang on, we've done lots of exploring.
There are lots of us having a go. Nobody's found 37 yet. Tell us about what you have found.

Then we start to draw together some ideas. So, having had that exploration, it's then the practitioner's role, the teacher's role to draw some of this together so that we can look together at what everybody has got and then we start to notice.

So as the teacher, we might say, what do you notice about what we have managed to do? Nobody's used ten numbers to get 37, but here are some examples of what we've done. What do you notice? What's the same about these? And then we begin to do that noticing element. So, in this case - spoiler alert - it's impossible to find ten numbers that add to 37 and children will begin to say, oh, hang on, I can do it with nine numbers, I can do it with 11 numbers. Or they might say, I've made 38 with ten numbers, and then we start to express these noticings. At that point in the webinar, we stopped because we had to be really careful that we focus only on the exploring and noticing and not go on to the next stages, which, might be a bit of systematic working, conjecturing and so on.

I hope that gives a little bit of flavour. In the webinars, we are encouraging participants work on some mathematics with us, examples from NRICH, to get a better idea of what we mean, in this case, by exploring and noticing and thinking about how in the classroom situation, what we as practitioners might be doing, what we might be saying, how we're facilitating. so that we're really helping children value this part of the process.

JT: I think that's such an important part of the mathematical process, that ability to explore and to be playful. And there can be that focus on trying to get quickly to an answer without necessarily enjoying that playful process that actually is one of the fun things about maths and it's also the part of the mathematical process where children aren't afraid. They're not feeling anxious. They're not worried about getting the answer right or wrong: that anxiety just hasn't set in and they're not solution-orientated, they're having fun, they're, they're playing and there's no anxiety, there's no pressure to come up with an answer. It's all about what they're noticing, what they're starting to find out about it, and there's no pressure on them at that stage.

LW: At NRICH, we often refer to that exploring and noticing as the springboard for the further learning because it hooks you in and it sort of opens the door to a world which then is the springboard for further learning which we like to think of it that way.

JT: Yes, and then you go on to that thinking systematically and so on: it's almost like you've come up with all this raw information, this messy information and now you can. As a class or in your little group. So, your pairs start to sift through that information and start to organise it almost, which I think once you've had lots of time to do that exploring that working

systematically, is less intimidating because you've really familiarised yourself with the initial part of the problem. So now you can start to work on the next bit: fantastic!

It sounds really, really interesting and as it's free, I would certainly recommend schools get involved. I do believe there's a logo involved.

LW: You are right, Julia. And as you were talking, I remembered that I hadn't mentioned the logo. You're absolutely right. So, once you've signed up and you've done your initial RAG-rating and you've identified three action points, we then we send you know, an image file of a Problem-solving Schools logo.

You can pop that on your website or on a letter-head, should you wish, so you can be proudly say that you're part of the Problem-solving Schools Initiative.

JT: Absolutely. I know from my own experience that those little logos are very important, we always like to have them on! But we are coming to the end of our conversation, and I was wondering if you could tell me where schools can go to find out more information about how they can get involved.

LW: Of course. If you go to the NRICH website, which is nrich.maths.org, no ‘e’ at the beginning of NRICH, it's just n-r-i-c-h, and at the top you'll see our menus and you'll see at the top, towards the right, there's a Problem-solving Schools link.

If you follow that, there are four boxes there and you'll be able to read a little bit more about what the Problem-solving School Initiative is all about. You'll be able to read the charter, and you've got all the links that will enable you to register your interest and kickstart the process.

JT: And I think it's important to note as well that it's not something where you have to enrol by a specific time period, and it doesn't have a start date or anything like that.

LW: At the moment, you're absolutely right. You don't have to register at a particular time or by a particular point in time.
It is more about, we will be in touch with you after a suitable length of time after your registration point to find out how you're getting on and to think about reflecting again on your practice, having done some work on your three target areas. So yes, there's not a deadline by which you need to register.

JT: It sounds like a really exciting and interesting project. It's completely free, and so I don't know why any school would have any reservation about getting involved. And I think it's really lovely that it's available for primary and secondary. It's lovely to think that they could be using the Problem-solving Schools Initiative to create that smooth journey for children from primary to secondary school when it comes to problem-solving, which is fantastic.

I urge people to take a look and get involved, but thank you so much for your time and we'll put links in the show notes to everything that we've talked about.

LW: Thank you very much, Julia. I've really enjoyed our conversation. Thank you for the invitation to chat with you.

JT: And that brings us to the end of our conversation today. Thank you again to Liz Woodham from NRICH for joining me.

If you found this episode interesting, you might also enjoy our episode on maths games with Liz and her colleague Ems Lord from NRICH, and Grace Coker, Maths Content Specialist at the EEF.

That episode explored collaborative problem-solving, mathematical talk, and ways to use games in the classroom and for homework. We'll include a link to that episode in the show notes. Finally, we'd love it if you could like this episode, share it with colleagues, and follow us on your podcast app.

And you can also join our mailing list by visiting our website, ncetm.org.uk. Thanks for listening.