

## **MATHSTALK by AMSI Schools (Series 3, Episode 4):**

### **‘Developing Number Sense in Young Children’**

#### **Speaker Key:**

LM Leanne McMahon

MG Marcus Garrett

SR Sarah Rose

LM Please excuse the poor sound quality of this recording. We're really hoping to get back into the AMSI Studios very soon. Welcome to MathsTalk by AMSI, the podcast that supports teachers and caregivers with making maths learning effective and engaging. My name is Leanne McMahon.

MG I'm Marcus Garrett. And we're AMSI Schools Outreach officers. As the schools and teachers begin to negotiate the transition back to classroom based learning, and as we continue to navigate the COVID crisis. We here at the AMSI Schools Unit are continuing to focus on providing ideas and tips for parents, caregivers and teachers as they seek to engage students with maths learning at home as well as in the classroom.

LM This is our fourth episode in Series 3 for MathsTalk in Term 2 of 2020. And today we're going to focus on developing number sense in young children. That is, how parents, caregivers and teachers can both stimulate the inherent curiosity in kids about numbers, and develop in them a strong sense of how numbers work from early childhood even prior to school.

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MG This episode, we're chatting with one of our Choose Maths Teacher Award winners. One of the ten amazing teachers of mathematics selected from across Australia back in 2018, Miss Sarah Rose, who is both co-curriculum leader in maths and deputy principal at Singleton Heights Public School in the New South Wales, Hunter Valley. Welcome, Sarah.

SR Hi there, everybody.

MG It's good to have you with us.

SR Thank you.

MG Now I should mention that not only have I had the pleasure of working alongside Sarah in my capacity as an AMSI's School's outreach officer over the past four years. But Sarah also at one stage worked with my wife, Linda [?], up at Muswellbrook Public School quite some years ago. We go way back in terms of professional connections.

LM Sarah, can you fill us in as to what you've been doing in maths education in your community over the last couple of decades? And what led to nomination for the Choose Maths Teacher awards?

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SR I was really humbled to get my nomination for the Choose Maths Teacher Award. It was a fantastic and an amazing experience. And I was amongst such a wonderful group of people. It often surprises people when I talk about my maths background. I didn't really like maths. I wasn't very confident and didn't have a great understanding of maths when I was at primary school in New Zealand. My strengths were in literacy, like spelling and reading. And I'd sit there in maths and the teacher would go through procedural tasks, those things that I would lag behind.

When I first became a teacher, I didn't really get into my maths teaching with a bang. I really, really struggled. Then I was lucky enough to rectify all of that by being involved in a draft trial of the Numeracy Project in Zealand where I received intensive training and mentoring, team teaching as well, and introduced me to a new approach of teaching mathematics. Numeracy Project was focused on developing children's conceptual understanding of numbers and their ability to use numbers to solve problems, and to also enjoy working with numbers.

I then realised that everyone can actually do maths, including me and including other teachers, and everyone can be a great maths teacher. I finally developed a love and passion for maths, which has now been with me for 20 years. Now I love inspiring other teachers and students in their [?] love of maths. And that every single student and every single classroom across not just in Australia, but the world, can actually be really, really good at maths.

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LM It's so good to hear.

SR I've hoped to develop this passion as well with parents as [?] children, because a lot of parents had negative experiences as well. Over the time I came to Australia, and then I worked in TEN (*Targeting Early Numeracy*) teaching with other teachers. I was a maths consultant for the Hunter/Central Coast region, which was fantastic working with lots of different schools. And working with teachers in *Targeting Early Numeracy*, programming, to try and get schools away from textbooks to more conceptual type, basically using manipulatives and conceptual understanding.

Also facilitating work with TOWN, which is *Taking off with Numeracy* and the *Numeracy Ninja* project which our principal, Shaun Graham, came in 2017 and he'd put that into his last goal. I was happy to work with him on introducing it at Singleton Heights Public School. That was lots of place value tabs with engaging tasks for children to do each day.

LM It's interesting to hear your story. It's actually quite similar to a number of other award winners who didn't have that mathematics but found a mentor or a programme or something that actually inspired them to really go on with their

maths teaching. What's next for you?

Do you think in leading your colleagues both at Singleton Heights and across the region, and as you say, around the world?

SR I've been part of mathematics strategic team that our director in the Hunter Valley has initiated last year. We're looking at differentiation Nrich tasks and looking at misconceptions students can have around that, so that when we tape [?] we know what children may stumble over, and how we can help those children with those tasks.

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MG It's been a recurring theme, the difference between following procedures in maths and gaining understanding of maths. That's something that we hear repeatedly from teachers, from parents saying, I did it this way, but I never really understood why I did it this way. It seems like you've really concentrated on helping kids with that understanding, Sarah.

SR Yes. I think it's really important to work in partnership so that teachers really know the levels that students go through and how to differentiate. As well as an understanding for parents that they can have a big part to play in their children's mathematical understanding and enjoyment of maths. It's really important to engage with parents as well through that.

LM Especially at this time when parents are actually far more involved in their children's learning.

SR That's why the partnership has to be really strong between the school and parents so that we can come together and develop children's understanding in new exciting ways.

MG Something, I know that you have a really good understanding of is that that number sense starts from a very early age, even pre-school. That's really what we want to focus on in today's podcast. Can we start by asking you what do we mean when we talk about number sense for children?

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SR I've read so many articles about number sense. I think Alistair McIntosh and his colleagues, Robert and Barbara Reys, really best sum up number sense as referring to a person's general understanding of number and operations. Along with the ability and inclination to use this understanding in flexible ways to make mathematical judgments. And then also to develop useful and efficient strategies for managing numeracy problems.

And the expectation that when you work with numbers and problems, that the outcome should make sense so that when we come up with a problem that we're not just guessing and going, okay, that will do. We're actually thinking with our reasoning skills does it actually make sense? To use a variety of internal checks inside them to judge the reasonableness of their answers.

MG What would that look like for a young child?

SR Very early on, it would look like that they actually understand they're not just rote counting, for example. They actually know that three means something. That it's comprised of a group. That they'd have one-to-one correspondence. That they have an awareness of different representations of the number. For example, there might be a dice that they can say, that's three on that dice. We can have three fingers standing out. We can have three objects that we can do.

They're actually getting an understanding of that three is bigger than two, three is less than four. Not just counting off numbers and so on and being able to view numbers in a much more meaningful way.

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LM One of the things that we've noticed is that many parents bring their Preppies to school or Kindy and tell the teacher, my child's great at maths. He or she can already count to ten, 20, 50, 100. You're saying that there's a difference between the ability to count by rote and number sense?

SR Yes, definitely. Research suggests that early numeracy skills are the strongest predictor of later achievement even above early reading, socio economic status and social emotional functioning. The researcher Morgan also found that students who enter and leave Kindergarten below the tenth percentile will remain below the tenth percentile in 5th Grade. When you come with early numeracy skills, it really does improve your chances at primary school across everything, then that's integrated in across all subject areas.

MG It places a whole new importance around not just reading to kids from an early age and pre-school, but also doing meaningful counting and mathematical activities with kids from an early age.

SR Very much.

MG Sarah, what do you think teachers can do and also parents can do to support their children developing this number sense from an early age before school?

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SR I'll start with parents, is that they are their children's first educators. I've got a six-year-old son and I know that it starts from birth. Parents have such an important role in instilling a love and enjoyment and integrating numeracy into everyday life. Just from early on, noticing things and what do you notice? What do you wonder? Having those questions and talking out loud, talking about numeracy everyday with their child. Singing number rhymes when they're babies, I can say you've got ten fingers, I can see you've got ten toes. Constantly having that dialogue.

When they're cooking, I'm making six muffins now. All the time instead of having an internal dialogue, having that dialogue, we're talking. Children learn so much through having talk model to them. We also have to model maths talk as well. Sharing picture books is wonderful. And you don't have to go out and buy expensive maths books or anything. You can just share any books. And there's so much numeracy in every picture.

Counting objects, “I wonder how many butterflies are on the page?” or, “Look, it’s page number two that you’re turning! This is the second page I’m turning”. Looking at art, tell me about the shapes you can see on this page. Also, when going out and doing some PE, you can throw a ball, skipping. I wonder how long it would take to count to ten with our skipping, counting backwards. You’re in the bath. This is what I used to do with my child with the bath plug. I’d say, okay, when you count back from 20 to one, then I’m going to pull the plug out. We go 20, 19 and so on.

Always remembering that counting backward is harder, so you’ve got to do a lot more of that rather than always counting forward. It’s a very natural thing we count forwards. But it’s really important to count backwards as well.

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LN Not just from ten.

SR No, exactly. Going over that, because they can have words like Tyrannosaurus rex, are very capable from an early age. My son was counting very, very early up to large numbers. But it’s just from myself modelling that to him. At home when you’re dressing, count with your child the number of buttons as you do up a cardigan or shirt.

When you’re doing the washing and you’re hanging it out, encourage your child to count the number of pegs you use to hang out the wash. And get them to do one correspondence putting a sock up, putting a pig on there. One peg, one sock on the washing line.

LM That’s such a good way of doing it rather than just counting as these parents say, they can count to 50. But can they understand the one-to-one correspondence.

SR That’s a really big thing. There’s a massive difference between rote counting and rational counting [?] forms pattern number sense in a child. Just like the alphabet, you think of the alphabet, children can go A, B, C over the song and they don’t actually know what the letter looks like or the sound that [?] a letter makes.

With counting, you can count numbers, it doesn’t mean that when you see them that you know what a three looks like or what three actually means. And that so much, that’s a conceptual understanding. And that is why rational counting is needed rather than just rote counting.

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MG It’s interesting that there’s a parallel there between the fact that in early childhood quite often we learn things by rote but don’t understand what it means. And counting is the same for many, many children, they can count. But then we jump forward to high school and even post high school, we often see in parents that we work with that they’ll follow a procedure to solve, for example, a mathematical algorithm, a subtraction algorithm or a multiplication problem.

They’ll follow a procedure without really understanding what the procedure means and what it’s actually doing. It’s interesting that there’s parallels both in early childhood and also in adulthood with the difference between procedure and understanding.

SR That's so true, Marcus. I have an analogy of a map that I share with teachers, is that would you rather have a wonderful map spread in front of you when you're trying to find a new destination and go, "Okay, I can see the whole big picture and I know where I have to go. I can see this park can be over there. There's streets over there..." Rather than being told, "Go up here, turn left, second right..." and so on. That's the procedural way. Whereas a map is giving you a massive, big picture of where you want to go.

And I myself would rather see the big picture of, "Okay, I'm getting a feel for what the whole area looks like", rather than just being told procedure of how to get there. With our maths, we need to make it have that big picture and that fun and engagement so that people think, "Gee, this is really important for my life", because numeracy is around us in every single thing that we do.

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LM You've talked a lot about what parents can do. How does that differ to the role of the teacher?

SR It's really important for the teacher to put aside how they may have felt about maths as a child, like I did, and really engage with maths as a really wonderful subject. If they engage with it in a really positive way, they can make sure that they facilitate a wonderful joy in the students that they have in the classroom as well. Their face lights up when they hear the word maths, is really important. Attitude is really a big one as well.

But effective teachers also have a good understanding of what number sense is and the different strategy levels children progress through. Right through from emergent learners who come to our schools who find one-to-one correspondence difficult through to them being able to count and add and subtract using objects and their fingers which are wonderful to use. Back in the day, fingers weren't a great thing. They are a wonderful thing to be able to use.

Having students being able to then progress from objects on to being able to imagine things in a figurative sense. Being able to realise that even if you put a piece of cardboard over something that the objects still exists. And then being able to extend the children through to being able to count on from a number. And they already know if it's eight plus five, they don't have to count from one up to eight, they can just carry on from eight. And then being able to go through to flexible groupings, that they can use double.

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If it's 'six plus seven', I know that six plus six is 12 plus one more is 13. Flexible grouping is what we want them to be able to get to. That combinations of numbers, that eight is made up of four and four and six and two and five and three. So that when they come up with, for example, eight plus five, they can group and go, five can be made up of two and three, so I could go, 'eight plus two is ten plus three more', things like that. And showing children how wonderful it is to be able to finally flexibly group numbers is a wonderful thing.

Working with teachers, giving children opportunities to work with manipulatives, concrete materials and familiar ideas, getting them to create arrangements and representations of numbers in different ways. As I was talking about before, I've been working with our Kindergarten children on different representations of a number on our Google Classroom. For example, five can be made up on a number line, it can be made up with five fingers, it can be made about a ten-frame, showing it on a ten-frame, showing it on a dice, showing it with tally marks and so on.

So lots of different ways of showing five is really, really good too. Discussing and sharing discoveries with children and solutions, having number talks, open-ended questions. "The answer is five, I wonder what the question could be?" And understanding that ability to work with simple maths operations, awareness of number of patterns and that numbers can be bigger or smaller and what's the difference? So, lots of things teachers do in the early years' classrooms. But making it fun is really, really important.

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MG It seems like there's lots of strategies and a fair degree of awareness that teachers specifically need in order to be able to lead their students through progression of maths learning, and so quite a bit of technical things besides that enthusiasm. But for parents, the key job is helping their child understand what numbers really mean rather than needing to worry about all the technical stuff that will be dealt with when the child goes to school. Really giving their children a love of maths and an understanding of what that maths means in an everyday context.

SR Yes, definitely. And lots of games like playing Uno and Snakes and Ladders. I call it *Trouble*®, I think they call it *Pop-O-Matic*® kind of games where they subitise, which is that immediate recognition of a number when they pop five. "That's five!" straight away. Through games, they get that immediate recognition. Putting dots on a paper plate and just quickly flashing them and having a little game of scavenger hunt. Putting them around and saying, "I wonder where three is? Go and find three objects. Where can you find three objects in the house?"

LM Putting some of those Lego pieces together. "I need a six, I need an eight, I need a 12." Those sorts of ones where they don't actually count how many dots there are. They have to work it out.

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SR Definitely. Lego is wonderful for fractions too, when they get older as well, that they can show lots of different ratios and fractions with Lego pieces. Lots of different objects around the house can be used. But games in the car as well. Sometimes I've been guilty in putting the DVD on. But there's so many things to notice and wonder outside of the car. When I was a child, I remember looking out the window a lot more than children sometimes do now.

Having those games where, even the car one with the colours, pick a colour of a car and you got to count how many cars you can see with that colour. Always choose white by the way because... (*chuckles*)

MG (*laughs*) There's a lot more.

LM It's just about integrating things. When you're cooking, "Gee, I can see that I've got half a cup of water in my cup, how much more would we need to get a full cup? Having that, what do I notice? What do I wonder?" Those kind of open-ended things. Going to the beach, collecting shells and putting them on a pattern: "I can see I've got this type of shell and then I've got this type of shell next". Making patterns. Going for a walk and seeing the number that's on the litter box and things.

MG For the teachers amongst us, how would you assess the extent to which a child has developed or is developing number sense?

SR There's many different types of assessment. I've been doing quite a lot of reading around this lately. Callingham and Dianne Siemon's work realises that best assessment can actually directly and immediately inform teaching, which is best situated in classrooms. That ongoing assessment is so important. This kind of assessment is often referred to as formative but not the only type, but it does shape subsequent teaching. Assessment in the classroom is essentially about setting up a dialogue between the teacher and student.

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In which the students provide evidence of what they can do and of the understandings they have constructed, and then the teacher provides feedback that guides subsequent learning. We use a lot of diagnostic tasks. And we've had some great professional learning come out lately with some new diagnostic tasks. And we've had some SENA assessment that we've been using for quite a few years and have been adapted around the national numeracy progressions.

One-to-one type interview is a really popular way of assessing, because you get a lot more out of a child when you actually talk to them rather than what they can put on paper in the early years, of course.

LM We'll put some links to these, again, on our resource page.

MG For those listeners who are outside of New South Wales, SENA is an observational assessment tool that New South Wales teachers are able to use in the early years for one-on-one usually assessment of students.

LM I think it's fairly close to the Early Years' Interviews that we use in Victoria and Queensland.

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SR Yes, and they're looking at coming up with some more diagnostic tasks. When I said diagnostic tasks, so just simple questions like "Explain what a picture of eight looks like? Is eight and five bigger or smaller than ten? Why?" If the answer is five, the questions could be and so on. Getting them to really get that number sense.

MG It's probably worth pointing out also to parents, they don't need to be overly concerned about these assessments that we're talking about. These are diagnostic tests or assessments that teachers will often do for children simply so they know how to take them forward. A parent shouldn't feel that, "My gosh, I've got to prepare my children for a test that they're going to do when they first start



School!" It's really just to help teachers get some information around where the child's thinking is at so they can take them forward in their mathematical learning.

SR Definitely. When we're questioning children, it's done in a very informal way. And we're also observing when they do activities and things, how are they counting, what strategies are they using? All of that gives us information that we can then go, "Okay, what do they know now? How can we move them along to the next strategy level?" Trying to make them think just at that level, we're just pushing them a little bit more to challenge themselves. All of these assessments are doing is helping the teacher gain an understanding of where we can help them best.

LM That's a really important thing that we do need to teach parents, that assessment is very different these days to what parents might have experienced. Now, assessment is really, "Where are you and what do I need to teach you next?"

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SR That's so true, Leanne.

LM I guess that's really why we asked you the question because for parents listening, we'd love them to know that assessment is no longer something to fear.

SR No, definitely not. There's a lot more variety now, rather than just the old paper and pen test set that you and I would have all done in our day. It's very much more that we have a mixture of strategies. And we also cater for those children who their written skills may not be as strong as other children, so that they still have an opportunity to express their understanding. Because lots of people have a great understanding yet they can't record that.

LM That's right. And why, if your literacy skills aren't good, should your mathematical skills suffer?

SR Exactly. A lot of problems are very wordy, and so it's about taking teachers in and students through as well, facilitating that maths language is really important. And that we need to actually focus on mathematics vocabulary and how to solve problems in a meaningful way. Because they can be very tricky things at times.

MG Sarah, did you have any top tips for good resources or any particular things that you would refer either parents or teachers to for helping kids develop number sense?

00:22:13

SR I give out a parent's counting and numeracy resource booklet which was developed by our Department. I give a kindergarten orientation that's got lots and lots of ideas of ways that parents can engage with their children at home without integrating lots of things into their everyday life. I've given some teachers a book called *Teaching Mathematics: Foundation to Middle School*. That's second edition by Dianne Siemon, Kim Beswick, Kathy Brady, Julie Clark, Rhonda Faragher, Elizabeth Warren.

That's a really good book that I really enjoy reading because it gives you such a good base about number sense and all the activities and strategies and so on.

It gives you an in-depth analysis of how to teach mathematics in an effective way. Jenni Way with her 'Number Sense Series' on *Nrich*, 'Number Sense Routines: Building Numerical Literacy Every Day in Grades K-3'.

LM I love that one. Love it.

SR Now that's a really great book. Number sense articles on YouTube, such as *YouCubed*. *YouCubed* is a wonderful resource site and the number sense articles on there is really good. 'Calculate.org.au', that's a fantastic site.

MG *(laughs)* You'll go a long way, Sarah.

LM Yes, Sarah.

00:23:20

SR Just Googling "number sense", also *Finding the Maths* which Cass Lowry bought out too, that was a really great document that she bought out lately. These are really good things that are coming out and a very, very helpful.

LM We'll put links to all of these on our website.

SR Robert Wright's also been a real champion in showing teachers how the children have different strategy levels. He's done quite a few different books, like for example, *Early Numeracy: Assessment for Teaching and Intervention*. Robert Jay Wright was a person who wrote the learning framework in Number which then turned to, he helped frame the (national Numeracy) learning progression as well.

LM We were just talking about him this morning.

SR All his books, Robert Jay Wright's books, I've got all of them and they're really, really good too.

MG Thank you.

LM I think that's probably a good place to leave it. You've been listening to MathsTalk by AMSI. My name is Leanne McMahon, and I have with me my colleague Marcus Garrett and the primary school educator and CHOOSEMATHS Teacher Excellence Award winner Sarah Rose, from the Hunter Valley in New South Wales. Thanks for MATHSTALKing with us today, Sarah.

SR Thanks, everybody.

00:24:24

MG Thank you for sharing your expertise, and in particular, your passion for teaching mathematics and helping develop that understanding in maths for young kids. The podcast notes for today's episode can be found on the AMSI Schools teacher support website, [calculate.org.au](http://calculate.org.au). And the accompanying episode notes will include some useful links and resources for teachers so you can explore the ideas we've discussed today in more detail.

LM You can also follow us on Twitter @AMSIschools or on Facebook by searching for CHOOSEMATHS. Tell us how have you been able to develop a love of numbers in your young children. Or if you're a teacher, what great number sense ideas

would you love to share with your colleagues. We can be reached via email on the address, [choosemaths@amsi.org.au](mailto:choosemaths@amsi.org.au) and ask or comment away. We'd love to hear from you.

MG Don't forget to join in with Cass Lowry and some of the AMSI Schools team in our weekly Twitter chat at 8pm on Thursday nights, that's Sydney and Melbourne time. Just look for and follow the hashtag #mathstalk.

LM Please share the MathsTalk podcast with your friends and colleagues.

MathsTalk sound recording production and editing are all completed here at the AMSI Schools Unit. Once again, please excuse the poor sound quality of this recording. We are really hoping to get back into the AMSI Studios very soon. Pre-production and editing for this episode is being done by Marcus Garrett, Claire Embregts and myself.

MG And a final reminder, check our show notes at [calculate.org.au](http://calculate.org.au) as well as the links and resources we've provided. Don't forget to subscribe to MathsTalk on Apple podcast. And follow us on Spotify if you're listening from one of those platforms, and that way you'll get new episodes straight to your inbox when they're released. Thanks for listening, and we'll catch you next time.

LM Bye.

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