Indigenous content Transcript

Leanne McMahon: [00:00:00] Hello and welcome to Maths Talk, where conversations in maths become part of your professional learning. I'm your host, Leanne McMahon, and today we're exploring an area that's gaining long awaited recognition in the Australian curriculum, the integration of Aboriginal and Torres Strait Islander perspectives into mathematics education.

This is especially important to us at AMSI because we are currently working on the new edition of the AMSI textbooks, which have been very well received by the Maths community. We really want to make sure that we do the Australian curriculum justice and do the Aboriginal and Torres Strait Islander communities justice in. Portraying their mathematics as they want to be portrayed.

So we've invited our guests who have been responsible for the content of our textbooks to come and talk to us today.

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Empower your teaching with ti. This episode is inspired in part by a powerful and timely 2024 article by today's guests, indigenous Mathematics from mainstream misconceptions to educational enrichment. The article challenges mainstream views and highlights the value of indigenous mathematical knowledge as a source of enrichment for all students.

I am joined today by two very special guests. Firstly, professor Rowena Ball, a world-class mathematical scientist based at the ANU Mathematical Sciences Institute. Rowena's early research in dynamical systems and [00:02:00] physical chemistry earned her in a RC future fellowship, and she remains a driving force in interdisciplinary science, but it's her visionary leadership of the Mathematics Without Borders initiative that will really resonate with our audience.

This groundbreaking program reshapes how we think about mathematics, challenging the long held notion that Maths is solely a product of British European tradition. Instead, Rowena's work celebrates the rich, sophisticated systems embedded in indigenous cultures. Everything from the non-numerical

pattern recognition to advanced signals like smoke, telegraphy, illustrating that mathematics lives in every culture and environment.

So welcome, Rowena. And secondly, Dr. Hong J. A fellow mathematical scientist who is currently a senior eco hydrology analyst with the Murray Darling Basin Authority. Hong has been instrumental in writing the indigenous content for the new AMSI textbook [00:03:00] series and has developed over the years a real interest in indigenous mathematics and science.

Welcome to you Hong.

Hong Xu: Thank you.

Leanne McMahon: So before we examine the curriculum and content itself, could you each tell our listeners about your roles and the work that you've been doing?

Hong Xu: I'm now still working with my database, but I'm still affiliated with ANU as Honorary Research Fellow and still supporting the supervision and some teaching about me is that, my journey on Maths and First Nations Maths is I start my career in this as an engineer and I learn.

Maths from a Eurocentric view and from basic Maths, like arithmetics, like s that, that every kids are doing at the moment. A lot of kids at the moment, to calculus then to, partial differential equations in fluid dynamics, I have been believing that, [00:04:00] kind of maths.

Everyone is learning all around the world for quite a long time. when I was in my engineer study and in my engineering research and work, and then after that, I. Travel and come to Australia and start doing, study and research, environmental science and energy science and, engaging a bit other, disciplinary work like anthropology.

And so it's quite. Multidisciplinary work and also doing some research on the indigenous knowledge system and the science. thanks for Rowena for having me. I joined the MSI i, the Mathematical Science Institute at ANU in mid 2022 and have a very valuable opportunity to be a part of the teaching and the research project as a research associate.

And that quite enable me a form, a journey of First Nations math and cross-cultural mathematics. And more importantly, also the truth telling of mathematics. [00:05:00] Yeah.

Leanne McMahon: That's really interesting and it's something that we're actually trying to, get across to our students that mathematics isn't opening a book and doing equations. It's opens such a wide world and you are really interdisciplinary. Thanks, Hong and Rowena, can you tell us about your Maths journey?

Rowena Ball: Yes. That is so true, Leanne. Hong, we were so grateful to have you for that year because of that truly interdisciplinary perspective that we aim to develop I'm an applied mathematician, and I've had a wonderful career working with scientists from. Other disciplines and with industry on modeling real world complex and emergent dynamical systems, to run successful interdisciplinary collaborations, you have to listen to and respect [00:06:00] other people's point of view. through a constructive dialogue process come to a common understanding, that is how you make groundbreaking advances on difficult problems. My career has also confirmed my deep conviction. Of the equality and value of the knowledges of all cultures. since I'm a mathematician with indigenous antecedents, I don't subscribe to the view that mathematics is exclusively European or Western knowledge. We are all human and and human beings. Mathematical creatures. It's just been one of the delights of my life to tease out neglected indigenous and non-Western mathematical knowledge in our research and teaching program. It's been very exciting.

Leanne McMahon: It's amazing the places that Maths can take you. I actually started off as a biologist and I've been a teacher [00:07:00] for many years. And then coming to AMSI, it just opened up mathematics to me and made me realize, wow, there is just so much else you can do.

And opening up into all these different cultures as well. It's just great.

Rowena Ball: Yes,

Leanne McMahon: All right, so the article I mentioned at the top of the podcast addresses a longstanding misconception that indigenous cultures lacked mathematical knowledge. As you mentioned that it was, often seen that it's a European construct. So how does this misconception still show up in schools or in teacher conversations today?

Hong Xu: so maybe I'll start would like to say that first is that we hear that a lot even today, because people were ask What I'm doing. And I said, yes, I'm still doing First Nations Maths.

at ANU and with Rowena, with professor Rowena Ball. and then they start to ask, so, okay, what is indigenous Maths? Or what is First Nations Maths? and they [00:08:00] say, okay, it's just 1, 2, 3, many. Actually our colleagues, Ray Norris, he already published a paper on the conversation in 2015, and I reckon he already argued this problem very well. Says it is definitely a lie, but after 10 years passed this kind of misconception is there around us Met some of the aboriginal friends and some of them, even believe, like says, okay, on our math system is 1, 2, 3, many.

But, I would say it's kind of misconception, has deeply embedded in the teaching and in certain culture system around us. you can see that also not only. Around us also, in academia as well. Like I just saw a paper one week ago and, it's published on the Royal Society.

It's one of the serious publishers by Royal Society and, all these scholars are from the Yale [00:09:00] University and they did some anthropological research on the Australians. Aboriginal numbers system and their conclusion is end up by saying, okay, the First Nations people here in Australia, the numbers system, the maximum numbers that you we use is like 20.

And we know that's definitely not right, but you can see some kind of. publications is still a very good journal, and maybe some teachers will just pick up that and use that because it's a good journal or it's a good reference. So there are still a lot of misconceptions around us, even in academia and also we, have some very strong gatekeepers.

Maybe Rowena can talk about this, like Michael Deakin and also maybe some educators still. I don't know if that's in Melbourne Uni, but definitely still in Monash. And they still think, okay, there's no such thing called indigenous Maths. And after we published the [00:10:00] paper, you mentioned, so they criticize our paper and point that to me and point to Rowena says, we are just, drag down the Maths education or something like that.

So. Yeah. Do you want to expand on that?

Rowena Ball: well, yes. I mean, schools still present. Mostly dead white European males of the last few centuries as originators or heroes of mathematics or even unsubstantiated people who may not have even existed such as Euclid, most of what is called school mathematics was developed within and comes down to us from ancient Indian mathematics. So the number system, algebra, trigonometry, the binomial theorem, combinatorics. And identities that are known as Pythagoras Theorem. The Fibonacci sequence, Pascal's Triangle. I

could go on Pels Equation. Gregory Leibniz [00:11:00] series. All were discovered and used in India centuries before the West. I think past generations of teacher education propagated demonstrable untruths, such as what Hong described, this or that indigenous society could only count up to three or whatever. I think that has changed, but. These sorts of stereotypes have become embedded in the community and still slosh around in general society.

Leanne McMahon: I agree with that. Rowena. I was taught 35 years ago, 2, 3, many, and. I had never had anyone tell me anything different. So when you look at the number of students that I've taught, . It's almost like now because we've managed to get it into the curriculum, we're actually forced to think about it. And some teachers [00:12:00] are actually a little bit worried about it, and that's why at AMSI we thought we'd really love to have someone who knew what they were talking about, contributing to our book rather than.

Perpetuating myths or as teachers sometimes do, just ignoring the bits that we're not sure about.

Rowena Ball: Oh. It's just been the most fantastic initiative. you talk about groundbreaking. Research and science. But I mean this AMSI initiative, I think is groundbreaking in the world.

Leanne McMahon: Oh, that's really good to hear. , Okay, so we've sort of started talking about the content. Hong let's talk about the content that you've developed. what does the indigenous content of the AMSI textbooks look like and how's it integrated within the curriculum framework?

Hong Xu: yes. actually what Rowena and I did way back to 2022, we still have very little understanding [00:13:00] if you ask us to do the same job, like back to 2022, we may not be able to do that because it's kind of. Teaching and the research project we've been conducting and we've been working very hard on this.

And I will say, so the, the time you ask, us to do that is very good timing. So we spend lots of efforts to understand and to collect to lots of. Archives and, and connect that and put that into the teaching and to the research. for the AMSI textbook, series that, so there are more than 30 questions and , for year five to year 10 students and

what we would like to do is to give some taste of First Nations mathematics for kids. So from the basic concepts, understanding the symmetry cycles, patterns, And to understand the quite complicated structure of First Nations mathematics

system. Software has grew to lots of kinship system [00:14:00] and which also includes lots of. Background or foundation to more advanced Maths, like the group theory, , and students need to start from understanding the probability and, They realize, the kinship system is very delicately designed and, principles inside is.

is deeply related to the knowledge in the group theory and, also the SA theory actually, which we regard it as a foundation of modern math or algebra as well. So, so, so it's kind of general design that, that we apply to write the textbook. From the simple ones then to the more complicated one.

But we always visit, back to the same context like the fishing and AQ talks

We want to emphasize the concept every day mathematics practice by the First Nations people and to really put the kids into the. Context what, first Nations people are doing in their every day and how they [00:15:00] apply Maths to deal with the real world issue. it is kind of the philosophy behind where we are designing these questions.

and actually before we. studied the national curriculum very carefully and made a very big table to understand, so which years requires what type of Maths knowledge and what kind of cultural activities suggested by the national curriculum.

we follow most of that to design these questions. But we didn't follow all of them because there are, there are still some misunderstanding of First Nations cultures and the Maths in the. current curriculum.

Rowena, do you want to add a bit

Rowena Ball: I just want to reemphasize that we need to include Aboriginal and Torres Strait Islander perspectives in mathematics education? Because all human societies that we know of. Developed and practiced mathematical knowledge in order to [00:16:00] function and prosper. We are a mathematical species. That's how our society develops. So isn't that something exciting?

Leanne McMahon: I think it's amazing. The fact that that article was in a Canadian, journal and it wasn't just looking at Australian indigenous culture. All cultures have, as you said, we are mathematical beings and we all have our own way of approaching it.

Rowena Ball: Once you grant other cultures agency and intellect, and the same desire to solve problems that are relevant to their societies, then you can start to join the dots.

Leanne McMahon: Hong, did you wanna add to that idea of why it's important?

Hong Xu: Yes, of course. If we understand, how different cultures, views mathematics or apply mathematics, we will have a better [00:17:00] general understanding of mathematics as well. it will help even the pure mathematicians to better understand their pure mathematics because that's another kind of view.

so the mainstream mathematicians, they have nothing to lose. By, studying other cultures, mathematics, especially the Aboriginal and Torres Strait Islanders mathematics, because I would say that on, well, only in age are the human beings, the, the all human beings understandings of mathematics.

Leanne McMahon: So, Rowena, your initiative, mathematics Without Borders has drawn national attention and some international, I suspect. can you explain what it's about and how it supports the work that we are seeing in these textbooks?

Rowena Ball: Well, maybe if I just give an example, I gave a talk yesterday for NAIDOC Week. In which I described some really cool mathematical knowledge practiced by experts of the indigenous Ika nation in the 19th century. It [00:18:00] was a real eyeopener for the audience. What we are finding in our research is that mathematical concepts. Including advanced concepts that are usually attributed as products of the development of European or Western mathematics over the last two or three centuries, and are taught only at university level. Were known to indigenous societies and expressed culturally. And we shouldn't be surprised at this because I've just said probably more than once, we, humans are mathematical creatures.

I'm talking about concepts that are claimed to be quite abstract and advanced . To be some sort of secret white man's business. By, a cadre of European pure mathematicians are actually there [00:19:00] in all societies and known and used by people in all societies.

Leanne McMahon: And that's one of the things that you talk about in the article, about this discussion of mathematics, what mathematics is and who can do it, who's allowed to do it, and who can do it. And I reckon that's really

important when we are dealing with students in a classroom, no matter where they're from or who they are.

What have you found out about, when you're talking about what Maths is and who can do it, what sort of come up in your research?

Rowena Ball: Well, those questions are social rather than mathematical, but if we want more mathematics and, better mathematical literacy. Throughout society and we do, I think, events like the COVID pandemic showed that we need to admit these questions I think one approach is to enhance the mathematical journey of all students through.

More truth [00:20:00] telling in mathematics history and recognition of, and respect for indigenous mathematical knowledge. And not only that, we look at how this knowledge. Can inform new mathematical and data science approaches to problems affecting humanity in the 21st century.

Leanne McMahon: can I turn to you Hong, and ask what were some of the challenges in ensuring that the indigenous content was represented? Respectfully and accurately and interestingly, and, all of the things that we need to take into account when we're, building curriculum, within the structure of the curriculum and the textbooks.

Hong Xu: Thanks. That's a good question and I'm sure after I Talk, Rowena has more insights. But the first issue, or first challenge I want to mention is the funding. So the funding is almost everything, especially like [00:21:00] you talked about.

It's in the community and it's with the elders. It's the people. But, if there is no funding to empower the knowledge owners, if there is no funding to empower researchers like us, to work with the knowledge holders and to let more people know, I would say. there will be always a challenge like this.

So there will be there, there there'll be always there. And also the second challenge I want to say is, is still, there are so many gatekeepers in current, education system or structure so. I mean, if, even if we wanted to do something, even we can feel a general vibe says, oh, we, everyone, loves First Nations culture and we want to know about that.

But when, when we really Okay. Says, or, or First Nations Maths, especially like Rowena. Touched that before, first Nations, first nations elders or [00:22:00] first Nations cultures are already touched. Zes, deep abstract ma

mathematical concepts. Then it will irritate a lot of people and, and zes people, especially like when says maybe.

they have a very Eurocentric view and they think, what we've been talking is just, making no sense and just turn down everything like we proposed. so that's, I would say the two major challenges, I can think of.

Leanne McMahon: So for teachers who are encountering this content for the first time, what advice would you give and how can they confidently and respectfully teach it?

Hong Xu: Yes, so we've been discussing this. agriculture has mathematics, but I want to say if we are trying to understand, the content like First Nations Maths For the first time, we need to try to understand the culture and the Maths together because, the Maths is [00:23:00] inseparable from the culture and each culture, like we said, we shouldn't say has its own mathematics, but they.

They prefer maybe certain beta mathematics and they master their beta mathematics. And, it's all part of the math system, but if you don't understand their culture and you will not get the mathematics system, our suggestion is that so. Like what we've done in the textbook. We'll always write a background information and if you feel that enough, you can go through to the Maths bit.

But if you feel that's not enough, you can do some research on Google or maybe in other publications to make sure you understand the culture. Then you go to the mathematics. that's my suggestion.

Rowena Ball: Yes.

Leanne McMahon: Is there a place that teachers can go to look for, more information about the culture?

Rowena Ball: Mathematics teachers , in my experience, are just wonderful people. I haven't met a mathematics teacher yet. Who doesn't genuinely [00:24:00] want to do the best for their students. They're passionate about their subjects. They really work hard in devising new and innovative ways of presenting material. And I think just. Have confidence in who they are and what they're trying to do and in their own skills. So I think mathematics teachers work under very difficult circumstances. They encounter a lot of Maths phobia. They are not always supported by their.

leaders and school principals and school boards they have difficult classrooms and work under difficult circumstances, and still they're passionate about their subject. So all the ingredients are there.

Leanne McMahon: I absolutely agree. And there's nothing like a staff room with a group of Maths teachers. the conversations that they have. To get teachers sitting around talking about these things, it's quite [00:25:00] exciting. I love it. When we talk about excitement, certainly in the teachers, what are you hoping that students, I'm saying particularly Aboriginal and Torres Strait Islander students, because they'll be seeing their culture represented in the Maths classroom perhaps for the first time.

what do you hope all students are gonna take away from it?

Rowena Ball: I take it outta the classroom

Leanne McMahon: Yeah.

Rowena Ball: because generations of Maths students ask their Maths teachers the same question. Why do I have to learn this stuff? When am I ever gonna use it? Right? and Maths teachers try to answer as best they can. it teaches you logical thought and problem solving skills and so on.

But I really believe that what kids are actually asking is how is this stuff lived in my life right now? How is it relevant to my community right now? So. In our [00:26:00] society, mathematics is seen as something you do at school.

It's confined to the four walls of a classroom, and that is unfortunate because the vast majority of people part company with mathematics around about the age of 13 or 14 in.

Indigenous societies, mathematics is lived in the community from birth onwards.

Leanne McMahon: Hmm.

Rowena Ball: and you've actually said that in your introduction, Leanne, that mathematics lives in every cultural space.

Leanne McMahon: Yeah.

Rowena Ball: So that's what I would say ways of taking it outta the classroom.

Hong Xu: Yeah, I agree. maybe we back to the textbook content a bit. it is why we designed the textbook to share as why, how Maths lives. Like lives in the calendar [00:27:00] system, lives in the songline drum, it lives in the daily life like fishing and setting fish traps, lives, things that we find.

It lives things. The playing, like the games We're talking in Maths 'cause the game is very important topic in Maths and we're always talk about. Chess or, or, or Poker. But actually all cultures plays, games and all, all these games. It's actually highly relevant to probability and playing, playing games means playing math.

So, so take them out, play games and that's learning mathematics as well.

Leanne McMahon: That's funny because, in writing the year eight, chapters of the book, I've been doing quite a bit of probability and probability is just such a great topic. My pet hate is a whole lot of questions in the textbook. Where they have to work out probabilities, they should be playing games and devising strategies because that's where probability comes in and working out if it's fair or [00:28:00] not and inventing games

. And it doesn't matter what culture it's in, as you said, everyone plays games, every culture has developed games.

Rowena Ball: One year I took a bunch of Kutant and Kurdaitcha kids up in, from Normanton up in the Gulf country. we all went to Mars. We went out of the classroom to Mars and what we did. Was play rugby league. so up there in the gulf country, rugby leagueis the only religion there is. So you have to be able to talk about rugby league.

And we went to play rugby league on Mars, right in one third, the gravity of earth. And we talked about how that is gonna affect the game and how that's gonna affect the size of the rugby league playing field and how to calculate that.

Leanne McMahon: Yeah.

Rowena Ball: and with the older kids, we could actually do a couple of simple equations

On the whiteboard. But then, we went out to the covered sports area and [00:29:00] played with balls of different weights, different masses to simulate

different gravities. But what happened was that the whole activity actually fed into. Quite subtle ways of improving your actual game on earth.

Leanne McMahon: Hmm.

Rowena Ball: And it does so, you know, that was Maths. That was Maths being lived and the whole activity was interdisciplinary because it involved something they love doing for a start, it involved a bit of planetary science. Okay.

Leanne McMahon: Yeah.

Rowena Ball: A bit of physiology because what happens to people in low gravity so we know a lot now about what happens to astronauts on the International Space Station.

If you look at the turns you've gotta do in the air, in rugby league that professional players do, and how that is done in low gravity, you can actually turn that around and feed it back into ways of improving [00:30:00] your game.

this is sort of Maths on country. This is Maths that is lived. This is answering the question of all those kids who ask, how is this relevant to my life now in my community?

the only time they get full attendance at the school is when I turn up and give a mathematics activity like that,

Leanne McMahon: What I wanted to get across, and I probably should have said this first, was how this isn't just a tokenistic thing. this is something that's really important for.

Not just Aboriginal and Torres Strait Islander students, but for all students

Rowena Ball: Very good point. That's a very good point, Leanne, I think Hong made that argument too.

This is, this has just gotta be good for all students because we are seeing Maths engagement and participation decrease year after year. I see these reports and [00:31:00] nothing seems to reverse it so far,

and that's happening internationally,

Leanne McMahon: Of course. Yeah. We had a really well-funded Choose Maths project for, five years to try and get students to choose that higher level Maths at year 11 and 12. And we worked with students of all ages and in remote, regional, and, urban areas.

Rowena Ball: There's always this sort of, you know, two or three or 5% of students who just love the, the European Maths that's taught and what to do more of it. And those are the ones. we see at ANU in the Mathematical Sciences Institute. and they're fantastic.

we love them, but what society needs to function, and this is what indigenous societies understood very well, is the next 20 or 30 or 50% after them

Leanne McMahon: Yes.

Rowena Ball: to be mathematically literate

In their daily life as young people, but in their working life after that.

Leanne McMahon: [00:32:00] Mm.

Rowena Ball: So sooner or later you, you've got to say, well, let's look around us. Let's look at the rest of the world. This European Maths business. Well that's great. And that was, motivated by. And fed off colonial exploitation, and in fact the runaway development of European Maths was financed by colonial exploitation and robbery and, and slave trading.

I've done all that. We did all that in our truth telling in mathematics history. We did that. But sooner or later you've got to look at the rest of the world and say, well. Maybe those societies that the European and British colonial powers came in and trashed. Maybe they've got a lot to offer in terms of mathematical knowledge, and that is exactly what we are finding.

Leanne McMahon: Ah,

Rowena Ball: It's absolutely wonderful

Leanne McMahon: ah, that is.

Rowena Ball: That has been suggesting, like I've said, [00:33:00] new mathematics has been suggesting new ways of looking at 21st century problems the terrible problems afflicting humanity,

so that piece on smoke telegraphy, I did. That immediately suggests things like, oh, can we put machine learning to work on learning a model for smoke flows?

So climate change has created vastly enhanced patterns of fire over the whole planet. Wildfire. So there's more smoke to deal with.

Hong Xu: And just one thing to add is that indigenous Maths on fire management already proved to be more effective than the large scale. fire prescribed burning, and then people saying, oh, it brings indigenous knowledge back. We need that.

Rowena Ball: Yes, you are right Hong. We are indeed seeing this great flourishing of indigenous scientific knowledge and that is a very good example.

Hong's referring to [00:34:00] cultural burning.

Leanne McMahon: Mm. We need to refer to people who know what they're doing

Rowena Ball: Yeah. Well, I hear you.

Leanne McMahon: Well, look, thank you both so

much for joining me today, sharing your knowledge and experience. It's been such an important conversation and I know it'll support many teachers across the country.

Rowena Ball: Thanks so much for having me, Leanne.

Leanne McMahon: My pleasure and thanks very much Hong.

Hong Xu: Thank you.

Leanne McMahon: I hope today's podcast has helped you to prepare to insert the indigenous content into your mathematics courses. Please check out the show notes for all of the information you need.

The AMSI textbooks will be out mid next year, so that you'll be all ready for 2027 and the indigenous content will be absolutely ready for you to work on.

Thanks to our sponsors, Texas Instruments. Don't forget to check out that free professional learning for teachers.

Leanne McMahon: Thanks for joining us. Goodbye. [00:35:00]