Research into practice conversations: Teaching the language of climate change science

Transcript

Julie Hayes: Hello, my name is Julie Hayes, and I'm one of the researchers for the Primary English Teaching Association of Australia, called PETAA. And this is Louise Kelly, and Michael Cannavan, two teachers who've been involved in our research. And I was the principal at Cowandilla Primary School for 17 years. So we know each other well.

We'll be talking about the research underpinning one of the units of work in this book called *Teaching the language of climate change science* that I co-authored with Dr. Bronwyn Parkin.

Now Louise and Michael have worked with Bron Parkin for well, as long as they've been teaching really, and as she's been a consultant here teaching us about scaffolding pedagogy that really supports students from disadvantaged backgrounds. And she's worked with the teachers here and with Dr. Helen Harper and other teachers across Australia to refine that pedagogy, you know, year after year after year, and Louise and Michael have been an integral part of that.

So how did we get to doing this collaborative research on climate change? In 2016 and 17, Helen Harper and Bronwyn Parkin won a PETAA research grant to look into how to teach academic language to marginalised students. Two schools were chosen, one in the Northern Territory and they focused on maths, but here in South Australia, Louise and Michael's class were used as a trialing pedagogy to teach science more effectively. They wanted to investigate ways that we could use-- foreground language so that students were able to write and to talk about science in extended cohesive texts or long explanations. Rather than just filling in in a closed exercise or one-word answers, we wanted our students to be able to use extended texts and explanations and arguments and reports around in this case, it was a topic of lunar eclipse.

So out of that research with Bron Parkin and Helen Harper and Michael came *Teaching with intent*, this PETAA publication called *Scaffolding language with marginalised students*. And then, because Helen Harper and Bron Parkin had been working with teachers all over Australia, refining the scaffolding pedagogy, which in South Australia was called accelerated literacy, they needed to record that so that they that could be shared with other teachers across the country.

So they wrote the next text called *Teaching with intent: literature based literacy teaching and learning*. So that's teaching English and literacy skills in in the subject area literacy, using literature. And again, Louise and Michael's work is featured in that book. So I'm telling you this so that you know that the two

researchers, Bron Parkin and myself, have worked for a long time with Michael and Louise and we know each other well. Louise and Michael were asked to join this next project on climate change.

Bronwyn and I were both interested in climate change. And when we realised that climate change is not in the science curriculum until Year 10, we knew that we needed to do something to help teachers to work out which bits of science actually relate to climate change. So we looked through all the sub-strands of science and we picked out those bits, and put them in a progression and then linked that to the cross curriculum priority of sustainability. I mean, that took quite a bit of work, because we worked with science teachers, the science teachers associations and lots of academics. So what we were trying to do was save teachers that work and make it possible for them to look at a strategic approach to teaching about climate change from preschool right through to year eight.

So we invited Louise and Michael to be part of that research to actually flesh out the continuum for the structure of this book, but we needed units of work to tell teachers, you know how they could possibly approach each topic. So Louise and Michael looked at the Year 5/6 science topic of states of matter and properties of solids, liquids, and gases. So that led us really neatly to looking at the greenhouse effect and the enhanced greenhouse effect.

Now, we know that mastering academic disciplines depends largely on mastering the language of those academic disciplines. For example, science concepts don't exist in the ether. They are developed through language, they are understood through language. And as students move through and sort of learn more about the issues around climate change those understandings and concepts are developed and refined. And indeed, they are often assessed through the use of language. So our approach was to try and help students use the technical language in extended explanations and reports.

And so the next step for us, the two researchers, and Louise and Michael was to bring all of these years of learning together, and to work out the best way to approach this topic of teaching about the greenhouse effect with our senior students. But before we go into exactly what they did, I'll ask Michael, just to tell us a little bit about the school and the class.

Michael Cannavan: Thank you. Julie. Cowandilla is a vibrant multicultural community about 10 minutes from the city of Adelaide, we're a welcoming inner-city school and children's centre, and we serve children from birth to Year 7. So we are culturally and linguistically diverse, with 64% of our students coming from a non-English speaking background. Our Year 6 and 7 classes had 51% of students having an English as an additional language or dialect background. And our classes had 48 students across our two combined classes, and we use our shared learning space for flexible learning groups.

Julie Hayes: Louise, can you tell us about what teaching the language of climate science actually involved? What did you do?

Louise Kelly: Yeah, thanks, Julie. So like Julie spoke about earlier, we started with the Australian Curriculum, because that has to be the foundation of whatever we teach. And as she mentioned, that solids, liquids and gases tied in really well to climate change, to then the greenhouse effect and the

enhanced greenhouse effect. And as she's mentioned, you know, overall with these units of work, and with ours, in particular, the aim was for students to have an uninterrupted turn so that they can engage in that academic language and show mastery of that of that explanation text. And that's both orally and in a written form as well. So covering both the greenhouse effect and the enhanced greenhouse effect.

And the idea is that we're immersing them in the literacy of science, and that they show that about understanding through the use of their language. And when we met with Julie and Dr. Bronwyn Parkin, and we collaboratively developed a focus text, that became the core of our unit. And essentially, it replaces that idea of a unit of work, it is your unit of work, and linking in with the climate change progression that Julie mentioned.

So in constructing that focus, text, all of the planning, all of the things you would normally put into a unit are all embedded within the language. And it becomes a really cohesive text to cover everything that you need, including the science content, as well as the literacy and I guess the English skills that we want our students to be using. And most importantly, when it comes to science, that we had references and credible sources of reputable scientific information, and that was really key.

So then within that focus text, we were then able to see what learning activities were relevant and when needed, and the focus text determined what those were. And that was both to cover the understanding and also the engagement. Sometimes scientific topics can be very abstract, and you can't exactly get hands-on version easily, so it was about connecting that for the students. And also to support the need for them to be constantly using scientific language. So that covered notes, visuals, demonstrations, interactive things, that that we found – videos and models and things like that, and of course, the text. So the importance of these focus tests can't be underestimated.

And particularly in our context, as Michael mentioned, we've got high numbers of students with diverse language needs as well as diverse learning needs. So nothing can be assumed or expected coming into a unit. Just because they're Years 6/7 doesn't mean they have mastery of that Reception through to Year 5 content. And we had to make sure that everyone had access to all of that prior understanding that would normally be assumed, we needed to make that all explicit. And that's a big part of this sort of pedagogy that we've been working on, as Julie mentioned, for over a decade, that there has to be a common understanding. And that's how you ensure that all of your students, regardless of their learning background, are coming into the learning with the equal opportunity of being successful and having mastery of that language.

And from a teacher point of view, we had pre- and post- assessments so that we could see and do a comparison of what did they know before and what have they learned at the end of the unit. And, of course, as being part of a project, our lessons were filmed. And then we met and debriefed at the end of every day, tweaked things, worked on what the research was telling us we needed to do for those next lessons to cover that key content and that key language.

Julie Hayes: Michael, can you tell us a little bit more in more detail about the pedagogies you used in this research?

Michael Cannavan: So underpinning the pedagogy, there's sort of two main big picture ideas, and that's about the focus text that Louise was referring to, and that that's that the focus text provides both the science content and the language needed for students to become participants in the scientific discourse. The other core concept being that we're moving from everyday concrete language to technical, abstract language. Going into now some of the more specific strategies that we would use within the lessons. And I'll try to give an example of how we used it or what the strategy was, how we use it, and why they were important to use.

So the one, the first strategy I'll mention is one that we call 'power up power down'. And that's connecting a common sense understanding of a concept with a scientific term. So what we do is we shift from common sense language to technical language (powering up) and back to everyday language (powering down). And doing this help students build strong connections between concepts and their meaning. At the beginning of a unit, we like to use or we tend to use more everyday language to introduce the more technical language that we're planning to introduce throughout the unit of work. And over time, and as we get to the end of the unit, we're wanting to see students using that technical language or having them power up and explaining the concepts using the language that we've introduced.

So an example would be with the topic that we studied, the greenhouse effect, we wanted them to understand about solar radiation being reflected from the Earth's atmosphere. When we introduced the term using the diagram that's in the *language of climate science* text that Julie showed at the beginning of the video, there was an arrow in a diagram showing solar radiation being reflected. When we first introduced that we talked to the students about here, you can see in this diagram solar radiation bouncing off the Earth's atmosphere. So 'bouncing off' that language, common sense, every day, not overly technical, to help the students understand solar radiation, bouncing off the Earth's atmosphere.

As we move through the unit, and we develop the understanding, we get the students to then begin using the term 'being reflected' or 'reflection'. So that's the idea of 'power up power down'. And the constant shift between those two terms, 'bouncing off' / 'being reflected', is giving the students the understanding of connecting the concept, and the language to that concept.

So next, another strategy that we would use or another pedagogy that we used is about maintaining positive affect. This strategy is aiming to keep students attitudes positive when they offer responses. And this is crucial in the scientific discourse with our students, with with all classes, but particularly for students from marginalised backgrounds, who like Louise was talking about earlier, and as Julie was mentioning, with the purpose of this research is to help students from marginalised backgrounds. And it's about like I mentioned, maintaining positive effect, particularly when student's responses are incomplete or if they demonstrate some misunderstanding.

So the aim here is to avoid dismissing or rejecting student;s responses. And, but to affirm their contribution. And we want to then reframe their contribution using our knowledge of the student, the topic, the class, so that we continue with the learning discussion. Now this can be challenging, because our default response, especially when we're, you know, in a topic where there is a correct answer, is to

to basically get the student's response, say, 'No, that's not correct', and ask another student for the correct answer. So, an example would be a teacher asking the class, 'What does the greenhouse effect do?' This, a student might respond, 'It cools the Earth,' and I would say 'No', move on, ask the question to another student.

I'd like to offer a different way of responding. So I'd be saying to the student that 'You're right that it impacts on the Earth's temperature, although it doesn't cool it'. We could then further ask 'Can anyone explain how greenhouse gases control the Earth's temperature?' by reframing the student's response in this way, we've affirmed their contribution. We've continued the discussion in an appropriate way. And we're now moving on to get the appropriate knowledge spoken about in the classroom and continue the learning discussion appropriately.

The aim here with this pedagogy is to keep the students engaged in the lesson. To keep that student but all students, we've invited the community of students to continue the learning, we've reduced any feeling of marginalisation from the scientific discourse from that initial student. And what the aim is, is to, of course, engage all students, but to prevent that initial student from not wanting to make further contributions in in lessons in the future.

So another strategy that we use is the very specific use of questioning, and the handover of long turns of talking, and the use of language through our questioning. We adjust and modify questions really deliberately, as we move through a topic, and we use questioning to revise learning and to hand over the technical language in a very gradual way.

At the earliest stage of the unit, we do more telling about the topic and about particular language. And we would expect less detail in student's responses. As the students gain more confidence and control of the language throughout the unit. Our questions, then expect more from them. And they elicit more detailed responses.

Because we have been so careful in our language choices, as we've discussed about our use of the focus texts and language choices with our topic, our handover of the technical language through questioning leads to talk and writing responses from the students that more closely approximates the language in the focus text, which is the language that we've specifically chosen to be scientifically accurate. And the language that we are wanting the students to be using, specifically.

Another strategy is what we call 'look back look forward'. And this is, in each lesson, reflecting on previous content, the 'look back', before continuing on to the next part of the teaching and learning sequence, the 'look forward', where this pedagogical strategy enables students to place or contextualize the lesson in the broader context of the work. It provides the students the opportunities to recall key language and concepts from previous lessons before moving on to the new learning.

This is done in a variety of ways. Through our questioning, as I've just mentioned, where we revisit things from previous lessons, such as diagrams, images, notes that we've taken rewatching carefully selected video clips, sometimes muted with teacher explanation, sometimes with the video explanation or just the commentary from the video itself, asking students to explain previous learning activities or

demonstrations, and asking them to explain the purpose of the previous activities in the context of the unit of work. There's many ways to do the ‘look back’. Sometimes it's very short, sometimes it's a little bit more detailed, depending on what the the next part of the ‘look forward is’.

The next one is probably one of the most crucial aspects of this pedagogy, which is about the intentional mapping of the language to the activity. Because this guides your work, and as Louise mentioned about the focus text being almost your unit plan and it is your focus throughout the unit, this guides your work through the lessons with your activities, your demonstrations, everything that you do. So your language selections are done purposefully and specifically to meet the need of connecting the learning activity to the focus text or the language in the focus text.

Throughout the activity, you will deliberately use the language that you want or that you've chosen for your focus text. And you'll use it consistently and multiple times. You will often have the students say the language as well. And you'll have them say it in the way that you have said it, and the way that you have written, it multiple times. This is important, the consistency of using it, because when you are writing the focus text or when you're wanting the students to use it, you want them to use the language in exactly the way that you do. So it's important because this consistency of your use of the language during the unit makes the connection for the students between the learning activity and the focus text, or the language in the in the focus text.

And that leads to the final strategy that I'm going to talk about. And that, similar to the mapping of the language, is about the oral language, and our use of visuals, and note taking, and how that leads to our joint construction of paragraphs in the focus text.

So, we create our focus text with students gradually, after each learning activity, and not at the end of the unit. Each learning, each learning activity or lesson involves, like I just mentioned, the specific use of some oral language or language, coming from the learning activity or visuals or demonstrations, whatever it is. And that leads to the note taking, and then the joint construction of a particular paragraph for our focus text.

So during our lesson, we will, for example, be watching a video clip or looking at some images. And we will be hearing or using particular language that we want to [use] eventually using the focus text, we will then do some note taking. Now depending on your class, you can do it and we've done it in a couple of different ways. We've done the note taking for the students where we've just written the notes, and had the students watch us. We've also had the students do the notes in their books or, or in a way while we've done them as well. So you can do, you can use either way. But the students will see that you are taking particular key language, that's important scientific language, from the learning activity, the visual the video from that activity. And you will then use those notes to create a paragraph and you'll jointly construct that at the end of the learning activity. And that paragraph will summarise the learning from that particular lesson.

So if we just think about the example that I gave about the ‘power up power down’ with the language that we were using there, so the solar radiation bouncing off, leading to the wanting them to use the term ‘reflected’ or ‘reflection’. So in our focus text, we had a sentence that read, solar radiation reaches

the Earth's atmosphere; some of this is reflected back into space. So the purpose there was to help them understand the term ‘reflected’, because we specifically wanted to use that in our focus text. Now the value of doing this joint construction at the end of the lesson rather than at the end of the unit, couple of points: students get to see you doing the note taking; they get to see you picking out from the learning activity, the visual, the video, whatever it be, the key language; they get to see you creating a scientifically accurate and well written paragraph; while you're jointly constructing it, they get to see you as the expert, talking aloud the decisions you make as a writer. And that's really important to help them when they are doing their own writing at the end of the unit, when we would expect them to be doing their own piece of writing or doing their own oral discussion, but in this particular sense talking about writing, that they are making decisions about how they use the language specifically. So constructing the paragraph with them is really important. And they get to hear you as the expert talking about the decisions you make as a writer using the specific language and specific terminology that you've got in your notes. Final last point, it also allows you at the point of need to talk about particular grammar that you can use in in the paragraph.

Louise Kelly: Yeah.

Julie Hayes: Because the grammar explains the meaning as much as the individual words.

Michael Cannavan: Absolutely.

Julie Hayes: Well, that's a rigorous approach. Louise, what were the outcomes for students? And you know, what were your insights? And has it changed your practice?

Louise Kelly: Yeah, thanks, Julie. I think this links really well with what Michael was saying. Because one of the key things that we found was that students coming into the learning did not know how to take notes. And we found this across all learning areas. And it was that idea of ‘I really like how a primary source has been written. It's written really well, and I can't write that well. So I'm just going to copy and paste that’. And we talked a lot with students around simply copying someone isn't showing your understanding. So even though in the unit of work, we would start with the talking, they would talk back. Eventually they transferred that almost that language in that script, into their own version to explain images, diagrams, animations to show that they did have that understanding. And I guess it's about transferring that skill set, not just within science, across other areas.

So, looking at a rich text that they found, being able to find key technical terms, being able to keep phrases together so that they're not changing the meaning behind it. But then setting aside that original source and using that in their own writing, so that they can show that they do understand in an accurate way. And and that's that's great for all learning areas, but particularly for science. So that was, that was a big one, the crucial element of note taking, I think.

Secondly was around the power of language and, and the positive affect. So Michael talked a lot about keeping them engaged. And I think it's around maintaining the integrity of your teaching, and not allowing an incorrect answer just to float out there and other students to think that that's the understanding, but to encourage students to give things a go, because the way that we can help

ourselves is by having a go. And understanding that part of your language was great, or the contribution and the engagement was good, but ‘I now know that that part wasn't quite accurate. And I've heard now the accurate response. And I can, I can join that with my understanding’. So that's really key. If we only want to hear the correct answers, then we're only validating students that almost had most of that learning coming into the unit as it was.

And I guess, when you initially are doing that, and you are having these long, long talking terms, and you're using a lot of technical language, you know, the negative voice in the back of your head is wondering, ‘are they really getting it, they're doing a lot of listening’, but the positive outcomes that were evident in their writing and in their oral expressions, and also we had subsequent units where students were connecting real life events they’d seen, and they were still able to use that technical language. And I think that you can't underestimate the power of that, that repetition. And that constant use, especially when it's something that's really unfamiliar. If you only saying it once yourself, as we all know as adults, we’re less likely to remember it. The more we are practicing and rehearsing, the more it becomes something that we understand, and then we can then use our own version of the language to show understanding outside of the unit.

And we've had students in this previous research that you mentioned, years later coming back and saying, ‘Oh, we were doing Adams in Year 9, and I remembered 5 years, 3 years ago, in Years 5 and and 6, how we did that’. There aren't other ways that we've been teaching, we haven't had that feedback from students that they still really understood it to such a deep level they're recalling it three years later, and using it in context.

So we were really fortunate that after we did the greenhouse effect, we did lunar eclipses. And Michael led that learning and we happened to have a lunar eclipse and the amount of emails we had from students, you know, in the evenings, on the weekends – never in a topic had we done had we had that level of engagement. And even students saying the images were too big. So I've changed their files. And they were out there looking at the eclipse, they were talking about the direct alignment, they were using the language that we'd really carefully planned and mapped. And they were so excited. And then they brought their parents and their families into that engagement of that scientific discourse. And I guess that's, that's the big takeaway: it does seem like a lot of work. And it is a challenge. And sometimes you get a little bit of pushback from students, because it is really challenging, but at the end of it, it's it's really worth it to see the depth of their understanding and how they can apply that.

Julie Hayes: Michael, what's happened since your involvement in this research? What opportunities are you offering for students around science?

Michael Cannavan: So I guess it's sort of about – where to, where to from here? Where are we going, what does that do for us? So for us, this pedagogy is something that we continue with, and we will continue to refine our practice with it and we think that it serves our students really well.

Something else that we want to do is to help other teachers build their capacity to use focus texts at the school. Yeah, absolutely. And with other schools as well, if they are happy to, we have had an

opportunity to work with other teachers at some surrounding schools and do some demonstrations and have some workshops with them, and would be happy to again.

But again, because we've seen the results and seeing the way that impacts on student learning. The way that it invites students to engage in lessons, we want to continue doing that, as Louise was just talking about the way that it invites students into the scientific discourse. Yes, we want it within our science lessons and in the lessons where we are expecting them to be engaged. But we also want them to be doing it outside of just that, the just the lesson here at school. So, when they're at home, and they've got screen time, we want them to be searching YouTube for science phenomena, going in and doing some of their own learning around that.

Here at school, we have a climate change group. Over the course of three years, it's doubled in size each year. And so, you know, we're hoping that some of this science teaching has been part of that, that it has developed the interest in that and so, you know, our big aim is we want students to think like scientists, to wonder like scientists, to observe like scientists, to act like scientists, and we want them to study science at high school, and university.

And, you know, one of the things that Louise mentioned earlier in the video was about, when we're creating the focus text was about, you know, seeking out reputable sources and using those. We want students to be able to identify scientific misinformation. And we want them to be able to seek reputable sources for their information as well, and we hope that through giving them this ability to use the language for scientific discourse and be part of that community, that they are able to identify misinformation and, and to challenge misinformation when it is presented.

Julie Hayes: Very important.

Michael Cannavan: That's one of the big picture things that we hope this work does.

Julie Hayes: So thank you both for being brave and engaging with the researchers from PETAA and for putting your practice on the line, and continuing to refine and to think about using evidence to change your practice and improve outcomes for kids. Thank you.

Julie Hayes and Michael Cannavan: *(simultaneous)* Thank you.