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CPL Podcast: Engagement in Science K-6

Host: Carly Boreland
With: Dan Sprange

INTRODUCTION:
You're listening to the JPL podcast from the Centre for Professional Learning. Here's your host, Carly Boreland.

Carly Boreland:
Welcome to the JPL podcast for the New South Wales Teacher Federation Centre for Professional Learning. I'm Carly Boreland and I'm the editor of the JPL. Today I'm talking with Dan Sprange about Engagement in Science in your primary classroom and how using engagement can be a good way to improve your Science teaching. Dan, welcome!

Dan Sprange:
Thanks Carly, great to be here.

Carly Boreland:
So Dan, you have had lots of experience teaching in primary schools, and doing some research into primary school education, especially around Science. Do you want to start off by telling us a bit about you and about how you came to be involved in this kind of research?

Dan Sprange:
Sure! I spent a lot of my career working in south western Sydney. Teaching was not my first career; it was a real calling for me. I guess from the onset my desire was to be in classrooms where students were wanting to be there and really engaged. I guess it came quite as a surprise to me in my first few pracs. that students don't necessary hang off your every word so the concept of *engagement* which had come up at my post-graduate program to qualify to be a teacher, the sort of framework around engagement became very important. And, pretty soon after I got fulltime employment at a school in Lakemba, I became part of the *'Fair Go Project'* which is a student engagement project. Through that research Science became one of the ways in which I could sort of live that dream (I guess) of being that teacher that engaged students. And as I sort of learnt more about what I'd done at University, and putting that into practice and that's part of the research project, I began to understand how the theories that had met the practice, and it was an incredibly rewarding part of my career. And I guess having worked in 8 or 9 schools in various capacities in south western Sydney and sort of leading that kind of thing with other people, I'm glad I get to talk to you about it today.

Carly Boreland:
Did you say that you're a principal now?

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Dan Sprange:
I am a principal now, yes.

Carly Boreland:
You're very modest! Sometimes people come in and they start with "*I'm a principal*". I love how you start with "*I'm a teacher*".

Dan Sprange:
I guess good principals, and hopefully I class myself as that, see themselves as teachers first and foremost. I sort of sometimes refer myself as a *teacher-learning-principal* because that's still what motivates me in my schools and I love being in the class and working with my teachers and making sure that's the sort of strategic focus for the schools I work in.

Carly Boreland:
Dan, at the moment, there's lots of acronyms around in education; there's *'STEM'* and now '*STEAM'*. Could we just focus, for a second, on why Science matters to you? Why teaching Science is still really important - sort of separate from some of those other sort of bigger issues that are going on?

Dan Sprange:
Sure, I don't really mind what we call it. But, for me, Science is this amazing opportunity as a human being and as a teacher and as a student who might grow up to do amazing Science. And it's this idea that we can overlay knowledge and inter-relate knowledge and connect ideas (that maybe haven't been connected before) and come up with something which is of importance to humanity. And the idea that, in primary schools, we can really set Science up as that huge possibility. English and Maths, they're tools for Science, if you really want to be hierarchical about it. So for me, that's where Science sits. It's powerful at that level and also, certainly in terms of student engagement - as we might talk about later.

Carly Boreland:
I've got to say as a high school History teacher as well, often along with my Science colleagues, we're kind of bit second rung down from the Maths and English teachers. But, Science is, (in lots of ways the revolution of Science I suppose), for a History teacher, from the Enlightenment period, Science as reasoning, and as separate from superstition, has profoundly changed our world in lots of really positive ways.

Dan Sprange:
The rigour that goes with Science in a world where you can push a particular view on anything to the contrary to what it actually is. Science is this wonderful stabilizing force that we have to use logic and reason and those same concepts forms a basis of what you do in classrooms.

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Carly Boreland:
I love how you say that English and Maths are tools of Science. I've heard plenty of Science teachers describe Maths as a branch of Science and there's lots of great stuff on their role of writing in Science and that great Scientists are actually great communicators as well because they can share what they know with the rest of the world not just with their scientific colleagues. Alright, so let's talk then about the actually doing of it. Dan, can you help us with why some students find learning Science a challenge?

Dan Sprange:
Yes, so if I go back to what I said earlier,which was about my reason for being in the classroom which was to see students engaged and learning because they wanted to. Often we see in school, students who see learning as work and not something they want to be doing. Human beings, and particularly kids learning is just, I don't know just part of being a human. When students aren't into Science, it's because we probably looking at front end loading too much information, and rushing through Syllabus material. There are pressures to do that sometimes. And the approach I've seen, and how we get students engaged, is to turn that around a bit and understand what *engagement* is and how things like *knowledge* are treated, and using that to bring students onboard.

Carly Boreland:
So the pressure of the Syllabus can sometimes be really front and centre in a teacher's mind. How do we liberate ourselves from that a bit?

Dan Sprange:
We often sit, at front of the classroom, thinking - "great! we've covered that! it's all good!" But, if we were to sit in the minds of each of our students, we probably would have a different picture. So, making sure we're building sort of durable knowledge which is deep and durable we need to let students have the time to *own* what they're doing. And maybe now is the time to sort of unpack the framework a bit - to sort of say what it says about how students learn and how it relates to Science. So, one aspect of the *engagement model* is that students need to have *high cognition, high affective and high operative* experiences. So, *high cognitive* is just that the learning is at a level which is meeting their needs and their *Zone of Proximal Development*, it's challenging – just challenging enough. The affective side of it is that they've got a *personal connection* to it. And in Science we connect them personally by creating this idea, for instance with an experiment, that we are going to find something out. It's not that I know the answer and we just look it up in a book. It's this *process* of working something out. The destination is the knowledge we come out of it with - so that's the *affective* side of the engagement. The *operative* is that the students are actually *doing* the doing. It's not a teacher, out the front, saying, - "this is how you do this experiment, I'm going to show you and you just sit there passively watching it!"
So, those three components, when you've got that as a sort of centre piece of how you're going to establish your learning sequences, [then] some things happen for children. If they're producing an experiment: they're designing an experiment with you; and running it themselves; and coming up with their own answers. They're creating the knowledge: it's not knowledge that's come from a textbook; it's

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not knowledge that necessarily needs to be told whether it's correct or not by the teacher. Of course, we're going to find a way to make sure that they're getting some sort of learning out of it. But, it's knowledge that is thoroughly owned. The message they get around their ability, through that process, is that "yes, I can have a go at these things, I can produce something valuable". That's where those tools come in, (you know the Maths and the English communication). Once you've come up with something [that communication] is such a viable component of the scientific process. Most of what I did in classes, and within the schools that I've worked in, we have made sure that when we are doing a really involved scientific investigation, or a design to make a process, that the students have a *forum* for exchanging their ideas and showing it to a wider audience. That's giving significance to their understanding and giving them really powerful messages about place in the school. I can probably go into some examples?

Carly Boreland:
It's definitely a perfect place to start! So, you're saying that when we teach Science, it can be integrated with other subjects but it's a discreet thing and there are some discreet things about the scientific process. *(Yes)* So we're engaging at this *cognitive, affective and operative* level and that we will have to deliberately plan that out. *(Yes)* So the things that I was thinking straight away already (because I teach high school I'm sometimes a bit frightened of tiny children running around everywhere) so I'm thinking how do we organise this and make it happen in a practical way? And then I'm also wondering about how do we make time for this? How do you do it so you're working with your colleagues together? How do you show off these amazing things that students have had an opportunity to think about and achieve?

Dan Sprange:
The practicalities of it, I guess, there's always these tensions between releasing responsibility to students and there's a skillset that goes with it and a culture that needs to be developed within a classroom. If that's not your classroom, at the moment, you can't just jump straight to that. So it's about students' understanding and gradually building that engagement and that belief that you believe that they have the capacity to do these things: that learning really is a negotiated space; the classroom isn't owned by the teacher. Of course we're there to make it work and teachers, who do this well, have really high expectations for students and they invest a lot of time in planning to make these things work and building that culture. There's the tension about (it relate to what we're saying before) that planning and getting through the stuff that you need to do. Primary school maybe is a bit different to high school. I imagine, that maybe, there's more pressures there with high school. But, certainly, my experience in primary school is that if you want to really understand whether your kids know, and have deep knowledge, and can integrate that knowledge and apply it elsewhere, you really need to invest the time - and not just push through. So, it really is a matter of taking a sort of nice, creative and intellectual view of your programming and sort of really going through and finding what those winning ideas will be. How do you tick off all those Syllabus areas and make sure you're integrating? I guess as you get better at that it just becomes easier obviously with the literacy side of things. If you've had an idea (when I

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was working with students on writing, for instance) to get them to write without actually having a purpose. When you've conducted an experiment and you've found something out that might be really be worthwhile for other people to know, you've got *real purpose* to communicate. Unfortunately, sometimes in schools, we're prone to getting students to write about stuff which, we know, is not leading anywhere. As an adult we'll never be asked to write something which gets put in a draw and never looked at again. So you're creating that real purpose for some of those things. Why do we do graphs? Not because it looks nice in our book, we do it so we can communicate to people some data from something. So obviously there's some explicit teaching which fits underneath that but there's this wonderful interplay between giving students the skills to do various components of the scientific process and the communication side of things and, as a teacher, piecing all that together into this wonderful set of sequences where students have the skills but the capacity to grow into the particular activity.

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Carly Boreland:
So, I'm thinking that as you do more Science in your classroom in this kind of way (where students are actively part of the thinking process as well as the doing) that you feel good about it too and so you become more inspired to plan more of this kind of work and become more confident as you get some success as well. Where do you start? Is it a one hour [activity] something that you can plan to start with the class or do you spend a couple of weeks working towards something? Where is a good place if someone's thinking -" I need to get better at what I'm doing with Science but I don't want it to become a bad experience that will turn me off trying something new"?

Dan Sprange:
I guess, obviously you'll go to your Syllabus documents. But for me I would look at the scientific process. How do you conduct a fair test? How do you conduct an experiment in a fair way? You'd start with something which is really easy to investigate so the learning – the explicit learning is actually "what is the scientific process?" so that you're not loading them up too much cognitively with discovering this particular thing.

Carly Boreland:
Could you just give me an example; sorry to interrupt you. If you're in Kindergarten, what's an easy thing to investigate?

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Dan Sprange:
So you might have two balls. One bounces higher than the other. We have to do a test to work out which one bounces higher. We would work out - maybe one student drops it from a higher spot than another student then we say 'Well is that fair?" We start working out what a fair test is. We start doing some tally marks etc. That might be a good place to start. We've got a set of words and concepts and metalanguage to help us in our future experiments where we are actually investigating something which maybe the students have a bit more interest in.

Carly Boreland:
And so then it can step up from there and the Syllabus, obviously, has details on what would be appropriate.

Dan Sprange:
You sort of referred to Kindergarten; I did six months on Kindergarten and it nearly killed me! I've tended to be sort of the 3-6 years [teacher] but I'd have to say these ideas do apply across.

Carly Boreland
I heard the second half of the first year of Kindergarten is much more survivable than the first half!

Dan Sprange:
Well I was in the second half; so I couldn't tell you. But it's the toughest year of school, I think, is Kindergarten (but that's just my personal opinion). I can probably give you examples of what this might look like in practice. I apologise, if anyone has heard this before, because, when I've spoken occasionally at conferences, I've raised this example. But it's just one that seems to piece it all together quite nicely. I had a wonderful group of Year 6 students at a school in Lakemba and had done a bit of fore-grounding about how to do a scientific experiment. We'd been looking at *persuasive text* writing and also how to write an *informative text*. We were looking at packaging and how various marketers make packaging make you think certain things – the visuals; the words; the whole bit. We got to looking at dishwashing liquids. Pretty boring concept, on the day to day thing, but to a student the packaging is actually quite heavy with meaning. So we went through a process unpacking that and applying a few of the ideas around how you get your message across. And then we decided – "well, we probably think this one's the best (based on the packaging) and this one's the worst." And then the question became – "how can we test that?" So, I worked out a way which we could pour the dishwashing liquid into a container with some oil and shake it around and get some idea on how quickly the bubbles disappeared as our little test. We did that as a bit of a trial to establish this process. And then students basically were given the opportunity to work out which one was best. So students divide off into little groups. I talked to you earlier about students being in that *Zone of Proximal Development[ZPD]* so the groups, that I had established, had a really nice mix of kids. Some students were natural born leaders, who were going to hold the group together and keep them into account. Had some students who were, maybe, really hands on but not the best readers and writers – their job was to make sure the logistics were working;

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so they were the ones pouring it all in and getting on with it. We had the students who just loved making sure that things were organised and attention to detail. So there are all these different groups but there is a place for everyone! Not based on abilities (these groups) - they're just a nice balance of students. *Collaboration* we know is a *future focus* skill, very important part of the process here. So the students went off - they used this process to test the different dishwashing liquids (having looked at what they thought which one would be best based on the very persuasive packaging). They were collecting data obviously - there's quite a lot of Maths there: you've got to average stuff; you've got to think about how many times you test each one. They do a blind test: some groups decided you wouldn't know which one it was - so there was no trying to give the best looking product the placebo effect.

Carly Boreland:
And the students thought of this?

Dan Sprange:
Yes, I think from memory

Carly Boreland:
That's great!

Dan Sprange:
This wasn't one lesson; this was over time because the students have to have time to really put their heads together. Fail a few times as well - because some of them just poured half a bottle of dishwashing liquid and you need a lot of oil to beat that. So they worked out their processes. All the while, I'm in the background. I'm not just going – "Well, great! While they're doing that I get to go and do something else." My job, then, is to bring it back to the criteria. We have criteria for what a fair test is and a good experiment. We say to them - "where are you with this? What's happened here?" Giving them feedback, which makes them think about the process and come up with the solution. Eventually all this feeds into a sort of audio-visual piece that they put together. I think we were using '*Photo Story*' which is basically - you have a picture and an audio over the top of it.

Carly Boreland:
So they might be taking photos while they're doing the experiment to capture what they're doing.

Dan Sprange:
Absolutely!

So, in the end we had groups who produced: they would take photos of the packaging; photos of the process they were using; the raw data; the graphs; and their conclusions. And a very different scenario (if we go back to one of the earlier questions) – very different scenario to me standing up in the

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classroom and saying - "This is how it is. I'm giving you the information. Now you have it, at some point later, you're just going to tell me what I said to you back in a test. We're all going to know whether you understood it or not."

The students (in that scenario I described, where they're doing this experiment) they're thinking about this beyond the classroom. The bell would go and they wouldn't really need to stop. And, at the end of it, they've got some information which is theirs. No-one else I know has done this (maybe Choice Magazine has, I don't know). But it doesn't really matter, for them and me in that room, I didn't know what the result was going to be, all I was caring that they were applying the scientific process well: that they were communicating effectively and going back to our criteria for how to do that. They can go back to their parents/families and say "don't buy that one, buy this one" Because they started doing analysis - "this one cost this much but it's twice as good as this; maybe that one is the better option". So, not every group did that, but there is a process where students can differentiate and apply these ideas beyond what I was possibly thinking and constraining them.

If I go back to the other aspect that the *engagement model* which looks at student messages around *ability*, student messages around *knowledge*, about *place*. *Knowledge* , in that case, is something which is thoroughly owned by them and powerful because it's got a purpose. "I can be the kid in my family, who can communicate some really high level stuff around how we shop!" for instance. In those groups, we've got students, who are presenting some really complex ideas about something, who aren't the high academic achievers but they've been in a group witnessing it (been very much involved in it) and suddenly they have something to say. To see those students, who have struggled through their education, in that setting actually suddenly being so proud to talk and to do that so well - to a teacher that's exactly where you want to be; in a room where you've shifted students to that level. I shouldn't sort of say that every moment in my classroom is this beautiful secret that I describe but, certainly (and I think that comes down to the complexity of teaching) when you're in the zone, you know you're doing a great job because you're getting that learning response. We can feel really satisfied being at the front of the class and chugging through stuff and ticking things off but where are the students? The school I'm at, at the moment, much more advantaged community, students are much more ready to be *consumers of education;* much lower levels of perceived disengagement. But, they're also very good at looking like they're learning and being interested. And that's a real danger, as well, because at some of the schools I've worked at, students will let you know very quickly if they're not engaged. It will come out through behaviours and so there's a really good guide there. But at some of these other schools you've got to be really vigilant, as a teacher, that you're actually stimulating those minds; that they want to go out the classroom and keep on talking about it.

Carly Boreland:
Just on that last point about the different types of students. It struck me when you were describing that incredible process which we should say is achievable wherever you are. *(Absolutely)* When you break that down to think actually what the children were doing what that would have cost to make that happen. It's all really achievable but it takes smart people thinking about the planning of it and those little bits

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that you were describing as being in the background. Those prodding questions; keeping back on track; knowing in detail the students; and how to put them together into groups that are going to work. There's so much that I've heard about whether it's students who come from disadvantaged backgrounds, or students who are Aboriginal students, or special learning needs - so much of what works for them works for everybody. *(Absolutely)* Like you said, we often don't feel that pressure to maybe be as good as we could be when we have more compliant students. But that's a real need and really works. So if you pitch it at that level you're actually helping your whole class - not just the couple who might be demonstrating that they're not totally loving what you're doing - actually everyone benefits.

Dan Sprange:
Yes, a sort of really good guide to that fact that students might be engaged (like I said before) - the bell goes they don't notice or the next day they come in and tell you about the experiment that they did at home. They know the difference between the learning they like and the learning they don't like. It's not about taking the easy option; some of this stuff is really rigorous. It's very high order; it's not just busy work, or even fun stuff. And, I think, sometimes we confuse *engagement* with fun. It's not fun necessarily. It can be fun but it has to be high rigour fun and embedded in the Syllabus.

One of the things that really allowed me to push these things along was simply having leadership within the school which created the expectation that we needed students motivated and engaged and giving permission to have a go at these things. And that's something I take away at my current position, is you've got to give teachers the ability (to have permission) to jump in and it's quite hard to argue against when you see this environment and when you see how the students respond. Parents see it - they know the difference when their kids are excited to come to school or are spontaneously talking about what they're doing. You know that conversation: "What did you do at school today? Nothing, it was boring! We did Maths." When they come home and actually initiate that conversation; that's really important data. And, I think that, schools who do this well talk about that success and celebrate it so that the entire school population is really understanding what's occurring in some classrooms.

Carly Boreland:
And I can imagine the students going home and those things from class marinating in their brain overnight. I can actually imagining them watching their parents wash up, or doing the washing up, and ticking over for them and I love how that's with some of our communities who would need the most help with English language proficiency but also the visual literacy component of studying what the packaging is trying to do *to* you and understanding that and being able to be aware of how that's working on you.

Dan Sprange:
Absolutely! And it is that concept that you walk outside and there are many questions that students have that we don't necessarily exercise in our classroom. It's a note for children to ask questions about

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the world around them and really want to find stuff out. I guess really good teachers can capture that and relate it to the Syllabus and build into these wonderful learning sequences which are really durable understandings. I like to think that students involved in this won't forget it; they'll remember those moments. I think if we look back at our own primary school years what do you remember? It's those magic learning opportunities and you take away a lot from that. So when you're in that tension between covering stuff and going into it deeper and having more ownership with students I think it's good to think back about what the long term effect will be.

Carly Boreland:
And, can we talk about the bit about results? In Science, a *result* has a different meaning sometimes to in other circumstances. So you can get a *result* where you find out that what you tried didn't work and that's still a *result*. Can you explain that a bit for us? And I was thinking of it because you were talking about how you yourself were involved in research and having the space to experiment, as a teacher, a bit and learn from what worked or didn't work. Can you sort of help us a bit with what that means as part of a scientific process?

Dan Sprange:
Yes, I guess for me interpreting your question there is the *result* is not a forgone conclusion it's maybe, it's not like Maths where we generally (and I know Mathematicians will probably say "it's not like that") but generally in Maths, we would expect an answer which can be confirmed or not. With Science, the results we're coming up with (if we authentically going along this process with the students as co-learners) the result is something that is unexpected: it might be problematic; it might be confounding; it might not sit with our other results and that just leads to more questions and more investigations. Sometimes you think - "I wish I could follow every possibility from this experiment and really sort of take that as far as we can".

Carly Boreland:
Can I ask you too about where '*assessment'* would fit into a process like you're describing with students engaged? You said, a little bit before, that there's really valuable data that comes out from students being keen to come to school. How would you go about assessing the *process* like you described with the detergent?

Dan Sprange:
Yes, I think schools are very data and evaluatively driven these days; which is not a bad thing. I think the biggest challenge though is making sure we don't lose some of these really important *stories* and we can look at attendance, and at all those more universal benchmarks. Sometimes it is those *stories*; you'll have a child who has spent most of their (and I don't exaggerate most of the) previous year sort of standing outside their classroom because it's just not working for them. Then some of these practices start to happen in their lives and little by little, they're just part of the main group. They see a place for themselves; they're part of a *community of learners*; and they're not on the outside. They are seeing that

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they have something to offer. I think, as a system, that is an incredibly important story to tell in terms of impact. There are a lot of amazing teachers out there who have that kind of success that will eventually show up in academics. It will certainly show up if we were to have a control, but we can't really control these kinds of things. But I've seen so many stories like that and - for the teachers, the parents, the communities that see that transition - it is profound and it is as a result of really hard work and determination.

Carly Boreland:
When we talk about teaching Science for K-6, Dan, you've really explained to us that it's a process where the teacher and the student benefit so much from thinking and preparing to have a truly engaging experience. And that it might not work straight away, but it takes some time and it's worth persisting with for the benefits of your students and community beyond just the K-6 Science Syllabus. You talked about some of the beautiful things about Science: that it is about collecting ideas together; it's about learning (because there is something deeply human about being curious about our world). And that we can work together with different types of students in the same group, who bring different qualities together, to find out something that matters to them and that they can benefit along the way both in social ways but that their learning can really shine and their knowledge can really shine as well. So there are lots of good reasons to re-think perhaps what you're doing in Science and definitely spend some time working with colleagues on it. We've been so happy to have you here today and thank you for sharing your insights with us at JPL podcast.

Dan Sprange:
It's been a pleasure, thank you for having me. Thank you.

Carly Boreland:
You've been listening to the JPL podcast for the NSW Teachers Federation Centre for Professional Learning. I'm Carly Boreland, and I'm the Editor of the JPL. Today I've been talking with Dan Sprange about teaching Science and using engagement strategies to improve your Science practice. To find out more and to listen to further podcasts you can visit our website at cpl.asn.au/podcasts.

CONCLUSION:
The JPL Podcast is produced by the Centre for Professional Learning and the New South Wales Teachers' Federation. All opinions expressed in this podcast are those of the individual speakers, and do not necessarily represent the views of their employer or associated organisations. The host was Carly Boreland; technical direction by Jason Nicholas.

Dan Sprange **has worked as an educator in South Western Sydney schools for 12 years. He is committed to creating the circumstances for student success in schools, especially those which service disadvantaged communities. He has worked as a co-researcher within the Fair Go Project, as a Teacher**

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Mentor, Casual Academic, Department of Education Consultant and Primary Principal. He has been an advocate for educational practices which result in strong student engagement and connection with learning. He is the former Principal of Hannans Road Public School and was recently appointed Principal of Russell Lea Public School.