Transcript of STEM connections project reflection interview

Steve Grant and Melanie Hughes with Dr Kathryn White of Merici College, Canberra

In 2015, ACARA conducted the STEM Connections project to investigate the effectiveness of using an integrated approach to the teaching and learning of STEM disciplines. In this podcast we interview teachers five years after their involvement in the project. Steve Grant, curriculum officer for ACARA's Digital Technologies in focus project interviews Dr. Kathryn White to discuss the lasting effects of the STEM Connections project at Merici College.

Steve Grant: Hi, this is Steve Grant, curriculum officer with the Digital Technologies in focus project and I'm here today with the teacher from Merici College who led the STEM illustration of practice. Would you like to introduce yourself and describe your role please?

Dr Kathryn White: My name is Dr. Kathryn White. I'm a Science and Engineering teacher Merici College in Canberra. I was the driver for the original STEM connections project here. We took a couple of our Year 9 classes and we drew Maths and Science and IT teachers together and over the course of 14 weeks we developed a project that was based around the idea of solar photovoltaics. And the kids in each class were taught, they remained in the same class, and they were taught science by their Science teacher and math by their Maths teacher, but the Science and Maths teachers worked together in order to integrate the content. And we planned the delivery of the curriculum so that we got the most integration possible between the science and the maths. We also had captured within those two classes all of the students who chosen IT as an elective, and so those students were simultaneously doing integrated stuff with our IT teacher.

Steve: So, what has happened after that project now?

Kathryn: So, the project itself was really successful in terms of the outcomes for the students. We saw significant growth in their ability to make connections between concepts in different subjects. We saw growth in their ability to take the initiative in experimental situations. Because we were doing a project that had a single theme, they ended up using the equipment, which was the photovoltaic setup, we used, they used that numerous times and so they

became so confident with the equipment that they were able to design experiments based on it, off their own bat, rather than always needing to be helped, and when things broke they could just, they could deal with it, which was great. From the teachers' side of things, it was a lot of extra work. So, our Maths and Science and IT faculties are located in different areas of the school. Getting all of the teachers together on a regular basis to make sure that we were in sync from week to week was a hard thing to do and it wasn't perfect. And that was one of the reasons why we didn't repeat the project in the same form in the following year. It wasn't that we didn't like how it turned out, but it was difficult to implement. It was also, there was some issues of perceived inequity in the sense that we didn't do it with the whole of Year 9, so it was like a subset of Year 9 who did this. We thought if we were to implement this as a proper integrated project it should really be with the whole year group if we're going to do it and that seemed too daunting at the time. So our solution to that, to kind of take what we'd learned and extend it but without the difficulty of doing it with the entire year group, was to institute what is essentially a STEM elective for Years 9 and 10. We're a girls school and we hadn't had science-based elective of that kind before. We have a sustainability elective where the students learn about sort of sustainable living and look after our kitchen garden, but we didn't have something for the more technically minded girls. So the STEM connections project gave us the platform from which to, or on which to, build this new elective. And we had a significant number of girls choose it the following year. So we had two classes, a Year 9 class and a Year 10 class and we took what we learned about the extended nature of the- the value of the extended nature of the project and built that into the Engineering elective. So the elective is based on, we call it Engineering, but they learn a lot of the underlying science and maths before they do each design project, so that it really is a STEM focus – they're not just launching straight into the design, and we make, whoever's teaching the course, makes explicit links with the science and the maths.

Steve: You're alluding to changes in the way that teachers teach their courses and teach the content and the subject areas themselves, how has your thinking around STEM changed and how has the pedagogy in the school been impacted by that change?

Kathryn: I don't think my personal thinking about STEM has changed, it's always felt for me, I've always felt about STEM that this is how science works in the real world – it isn't just science in a silo, it has to use math and it has to use technology, and engineering is based on all of that, so there's no way that you can- separating them is artificial, but when we're in the classroom sometimes you have to focus on a single subject at a time and we do our best to integrate it but sometimes assessment or the timetable or whatever gets on top of you and you don't make the links that you would like to. So the STEM connections project was brilliant because it gave us a chance to explicitly make those links, to make that the focus that we were making those links. And then when we turned it into the elective the following years, the elective then becomes a chance for the teacher to explicitly make those links, so even if the kids are perhaps missing some interesting connection in their normal Science or their normal Maths class, then in Engineering that link will be made for them or they will discover it for themselves. So I would say that it hasn't necessarily changed the way that we're thinking about STEM but it's given us a clearer opportunity to show the integration, to illustrate the integration.

Steve: Interesting. Have there been any changes in school context that have had a positive, negative or neutral impact on the way that you are able to do STEM or to implement these projects again?

Kathryn: No significant changes in the last sort of four or five years. We have had a lab refurbishment which gave us the chance to build a makerspace, which has been of great benefit. We previously had no electives that involved woodwork or metal work or things like that, so we had no workshop-type classrooms. So the makerspace acts as a space in which the Engineering kids can build stuff. So that's been incredibly useful. We were also lucky enough to get some funding to purchase some 3D printers, so that's allowed us to bring in 3D design and printing as part of the Engineering course. In terms of context, there has been some teacher turnover since the original STEM connections project. So we've lost a couple of the teachers that were involved in that original project, but there's been enough continuation of teachers that we have continuity – and while I've been the one that's driven the Engineering project, there are two other teachers who have taken over teaching those classes and they've been great, so we're sort of working on building the course together over time.

Steve: One of the significant challenges around maintaining sustainability of these kinds of projects is the loss of the intellectual capital. What steps have you taken to make sure that the project survives the turnover of staff or the loss of key drivers like yourself?

Kathryn: We've got, so as I said, there's more than just me – we have two other teachers who've taken on teaching these courses. But in addition, the resources that we've built for the course are saved from year to year, saved and improved on. So we have a structure for each of the four semesters, two in Year 9 and two in Year 10. We build each semester around a particular theme of engineering and that leads to particular design projects that end up being the focus. And from year to year we're improving those design projects and saving them so that if people come in later, even if they want to change the details of the course, that basic structure is there for them and it has all of the- our learnings over the last couple of years have been implemented into those assessment tasks.

I didn't finish answering your question about collaborating with other schools. So yeah, over the last three years not so much, but in the last year or two I've started kind of putting out feelers to find other schools around the ACT who are doing similar things. And yes, so I've made some connections – SFX, so Saint Francis Xavier, is one of our other Catholic Education schools, it's over in West Belconnen. The physics teacher there, I just happened to be on a PD with him and we got chatting and so I shared all the stuff that I've been doing, and they've now instituted something similar. And I'm meeting up next week with a woman from Brindabella College, who is their head of Science, who wanted to have some kind of STEM elective, so I'll share all my assessment tasks and thoughts and things like that.

Steve: Could you talk to us about the industry connections that you made as a result of the project, whether you have made any, whether there are plans to make any in the future or to include them in further implementation of the STEM connections project?

Kathryn: We didn't make a strong industry connection during our STEM connections. We had a couple of informal interactions with companies who lent us guest speakers who came and talked to the kids, which was brilliant. But since then, and having seen the impact that those speakers had on the kids, they were really interested to see people from out there in the real world, it stimulated me, so as I was designing new assessment tasks for the Engineering course I went looking for real-life contexts that we could use to build an assessment task around. So for instance, back in 2016, I think it was about the time that the first feasibility study for Snowy 2.0 was being done and SMEC, the Snowy Mountains Engineering Corporation, have an office just down the road from us and one of the engineers actually offered, he knew us via a family connection, knew of the school and said, 'is there anything could I be of assistance?', which was brilliant. So I sat down with him and he talked me through the basic idea of the feasibility study and we were able to turn that into an assessment task for the kids, where they worked through a simplified version of the maths, in which they calculated if you had- so, well, let me backtrack a sec.. So I got a connection with Windlab, which is a local company, it's based in Canberra but they have offices elsewhere, they manage a whole bunch of wind farms in Australia. My connection from Windlab gave me some data on South Australian wind farms, or actually all Australian wind farms, but he aggregated them together. And using that data we set up a kind of story shell for the students where we said, 'imagine a situation where Australia, during that time of the Kyoto Protocol, really committed to renewable energy and South Australia is now at a point where they're just about to go 100% renewables and here's the data that shows the production of energy by their wind farms and here's the data that shows the power that's being used'. So Windlab was able to give us both this usage and production data. So the students analyse that data to work out where the peaks and the troughs were and you know what kind of power mitigation you would need, because of course the wind power is variable, and we said, 'okay, well one way of providing that mitigation is pumped hydro, so let's calculate if you were to institute a pumped hydro system how big with the pipe have to be to meet those power peaks?' And the data that we collected was from I think early in 2016 when South Australia had a couple of incredibly hot days and there were these massive peaks in power usages everyone turned on their air conditioners and so it required a lot of power to meet that. And so the kids went through, they did the maths and they figured out that you would need to drill a hole that was, I think, 19 meters in diameter to get enough flow to meet that power demand. And then of course they researched and found that the biggest boring machine in the world is only 18 meters in diameter, so they had to go back and recalculate for a smaller pipe but more of them. So that was a- it was a great project. It was hard for the kids, it was quite challenging, like they were bringing in, they're only Year 9s, bringing quite a lot of maths concepts it's to make this work, but it was in a clearly real-life and very contemporary context. The SMEC people came and provided the context for us, so they introduced it to the kids and they stayed around to help them with the calculations and several lessons, which was brilliant, and yeah they came out of it with the kids sort of writing a report to say, 'here's what I've calculated, here's what I recommend if I was the engineer,' issues like, 'what are we going to do with all the spill? When we drill that hole where's all that extra rock going to go?' Things like that. So that was a really valuable industry connection that we got. Other connections that we've made have been again more informal, not so much with industry

but definitely with local universities. So the University of New South Wales Canberra has been fantastic. Our Year 10s have a space theme across the whole year – so the first semester is based on mechatronics and they built an Arduino-powered robot hand and in the second semester we do rocketry, so chemical powered rockets. And UNSW Canberra have provided a number of activities for the kids where we could head over to the university and they provided us with just a lot of kind of aeronautical context. There was one day where their undergrads had had to put together an activity for school students that would enthuse them about aeronautical engineering, so they had a couple of things there. They've also sent guest speakers out to help us out. It's been, yeah, they've been incredibly generous with their time.

Steve: Those opportunities, they may have just come up, are they things that you could leverage again in the future do you think?

Kathryn: Yes, definitely. All of the people who have helped us along the way in various ways have been incredibly generous and open and said if we can do this again we would love to. So we're lucky.

Steve: Do you feel like it's impacted on the quality of teaching and learning that's been available for students and for teachers as well?

Kathryn: Yeah, I do. Yeah. We have not only the teaching in the classroom but it's also opened up a number of extracurricular opportunities that we weren't aware of before – competitions and popular science days to get the kids enthused. We sent the kids to the Women in Aviation conference this year, so Women in Aviation Australia, and we had a couple of women there who are pilots or engineers in the aeronautical industry just offering, 'we'd love to come and talk to your students, when can we come and talk?' So yeah, it has, it's opened up a lot of opportunities for us.

Steve: Could you just repeat that point again about approaching universities and approaching industry, even with a cold call. What was the impact there?

Kathryn: Well just that- so I think you're right and that's about being specific about what you want and what I was going to say, I'll come back this in just a sec, I think I was really lucky with the SMEC guy because he was willing to give up an afternoon where we just sat down together and brainstormed from scratch what an assessment task would look like, that's pretty rare I reckon –

Melanie Hughes: That's lovely.

Kathryn: – for someone to give up that time. But for most of the other things, yeah, it's been, 'ok, so I have this idea and here's what I need to make it work, can you help?' Like the Windlab guy. So we'd already brainstormed the thing and I was like, 'I need some data on the power from wind farms, who do I look for?' I just kept googling companies and then, actually it was our sustainability teacher who knew of Windlab because she'd done some excursions to wind farms and stuff and she said, 'this guy, try this guy.'

Steve: Do you think you have the skills and knowledge to plan and develop units in STEM in the future that are different to this context? And being mindful of what skills they are, how would you then induct or bring in new teachers into that mode of thinking?

Kathryn: Yeah, I think I do have the skills to take this further. I've certainly learned a lot putting this Engineering course together. You always think at the beginning of something, or I think, the connections will be obvious, we'll just kind of- it'll just flow-on, and then you sort of make your way part way through a topic and realise that a connection that you thought was obvious the kids haven't actually tweaked to. So planning and running the Engineering course has been a constant process of improvement, where we sort of, we decide which are the connections that we most want to emphasise and what's the best way of bringing the kids to the point where that becomes obvious for them and what skills do we need to get them to practice so that they're not afraid of trying to make these connections for themselves, rather than just always you know reaching to the textbook or reaching for Google or something like that. In terms of bringing other people along I think it's, I don't do this planning in a silo, because in most years since then we've had two Engineering classes, I don't teach both of those classes so there's always another teacher to talk to. So we sit down together and we talk about the assessment tasks and decide having run through it, what could be improved next time? What do we need to adjust to make that work? Technology, like the 3D printers, it takes time to learn, so yeah, we sort of we sit down together, we work through the difficulties, there's always issues but you get through them and the more the other teachers become confident with this technology, the more I can kind of step back and let the program run.

Steve: In looking at the STEM project that you've got going at the moment, with what seems like a strong emphasis on the Design and Technology aspect, what opportunities do you think exist for further incorporation of Digital Technologies into that?

Kathryn: So yeah, at the moment the Engineering course is written under the Australian Curriculum's Design and Technologies curriculum, so that's the focus of the assessment design and etcetera. But because it is STEM-based, I did want to bring in technology as much as possible, so for instance we have the 3D printers and we have the 3D design, we use Tinkercad at the moment but I'm thinking about changing into Fusion 360, but just giving the kids that kind of technical, the use of technology in design. In Year 10 we use the Arduinos and they learn a bit of coding. But we do also have a separate IT elective, so I'm mindful of not stepping on the toes of the- we don't want too much overlap between those electives. Ideally, if you've got a kid who really liked coding and wants to take that route they would choose IT and if they also liked design then they would choose Engineering. But this way at least the engineers get a taste of the coding and they get exposure to the technology and we're helping to kind of broaden their horizons so they can understand how all of those different aspects are melded together.

Steve: So I guess the STEM project has been about the transdisciplinarity of skills across different learning areas. Do you think learning those separate, so you've got an IT elective you've got Science, you've got Maths, do you think the way that they do their teaching has

been impacted by the STEM connections in the way that they now look for more opportunities or are they more closed down in the ‘this is our silo, this is what we do, this is our speciality’?

Kathryn: I don't think they're closed down as such, but I also don't think we've progressed far enough that the Engineering elective is impacting on the core subjects. However, we're making the transition to the IB Middle Years Programme, where we've transitioned our Year 7s and 8s and we're about to transition to the Year 9s and 10s and one of the focuses of the MYP project is interdisciplinarity. So that's going to provide the, and there is in fact a requirement that a lot of the assessment tasks are across disciplines, so that's going to, I think, provide us with the impetus and a lot of opportunities to do those kinds of things. And the sorts of things that we've done in Engineering could potentially be extended to be say Science-Maths projects, rather than just in Engineering and then Engineering can move on and try other things. There's a lot of opportunities for that to happen.

My husband's an engineer at, so he was originally in Physics, he’s now in the Engineering department at ANU, and what they have found is that they get many more girls enrolling when they provide some kind of social context for their engineering. They have a 3rd Year Humanitarian Engineering course that was set up by one of their academics there, and it just, like, they get women and the women will love it and then that enthusiasm translates to the other areas of engineering as well. So when I was designing it, I was like I want to design a course that is not just going to be ‘we're going to do building stuff’ because, you know, definitely engineering is about building stuff, but we're going to try and give it a social context. So the Semester 1, Year 9, they do the bridge building thing, that's pretty standard, but then the second assessment task they do is assistive design using the 3D printers. So they put themselves in the position of a person who has say arthritis or some other bodily weakness, they brainstorm everyday things that would be hard to do, and I should say this is not original idea I got this from someone else, but they brainstorm things that would be hard to do and then they design a tool that would make it easier to do that using Tinkercad and then we print it and test it and evaluate it and so on. And they get super like keen about it, they’re sort of really- and some of them go and find relatives who have arthritis or something [and ask], ‘can you test this for me, does this work?’ And then in Semester 2 we have a humanitarian engineering focus, so those solar ovens. Next Thursday we've got a woman who's the head of the Engineers Without Borders in the ACT, so she'll come and give them like a broader focus. \

Melanie: It's interesting you should say that because one of the key concepts in the Digital Technologies curriculum is impact and the way that digital technology can change the world and do good, and I think that is hugely appealing for a lot of students and as you say the context is really important.

Kathryn: Yes.

Steve: Have you tracked what your graduates are doing? So this was –

Kathryn: A little

Steve: – the STEM connections was how long ago now?

Kathryn: So 2015, I think, and our elective started in 2016.

Steve: Ok, so you've had those students that were in Year 9 now –

Kathryn: Have just graduated last year.

Steve: – just graduated last year.

Kathryn: So yes, I know that- what, I guess, the problem is we're quite a small school, so our stats are, you know, it's not like I can say, '53% of our students have gone on to do blah,' but I do know, for instance, that one of my top students in Year 9, no she was in Year 10 in 2016, so she's been gone for two years now, at the time was certainly very interested in science but didn't really know where she was going, but just had such a talent for design, like applying science to design, her journals, like her design journals, were amazing. She was so thorough. Like I showed her Year 10 bridge design journal to my husband, he's like 'that looks like university work'. And she has ended up with a bit of an aeronautical focus, and I took her as a student to the Women in Aviation conference at that year, and she got super enthusiastic about it and she's now doing aeronautical engineering at Sydney Uni. So, you know, so I have a lot of kind of one-off anecdotal things, I don't have any kind of nice strong data sets to show this is the impact, but we have had, over the course of the time that I've been at Merici, the numbers, or rather the proportion, of kids that are doing Physics and Chemistry in Year 11 and 12 has strengthened. So yeah, we're kind of, you know you always hear stuff in the news about how the proportion of students, and particularly girls, doing higher levels of Maths and the hard Sciences is dropping, that's not the case here.

Steve: Bucking the trend, I like it.

Kathryn: Yeah. I'm not sure that I can attribute that specifically to the Engineering course, but certainly it has a lot more visibility than it used to, like those courses have more visibility now. Certainly when you've got a whole class of Year 9s out in the quad building solar ovens, people walk past and go, 'what is going on here?' So yeah, it's one positive factor in what are probably a number of positive factors.

Melanie: But I think too, one of the things that's really lovely about all of the things that you're saying is, particularly obviously trying to think about how we can show girls where the opportunities are and what's possible, you know, you've definitely done that, to provide all these opportunities and just to have, you know,knowledgeable enthusiastic women in teaching roles to provide these opportunities for them is so powerful.

Kathryn: It actually kills me when I take the group of engineers out to competitions and things and we'll be competing against co-ed schools who are also bringing classes and the co-ed schools will be like 90% boys. Like where- if I can get a class of girls, surely you can get at least half of a class of girls.

Melanie: Well I judged, the F1 in Schools competition last week and there was one all girl team.

Kathryn: Yeah. Where were they from?

Melanie: They were from Cessnock High School, I think.

Kathryn: Oh wow.

Melanie: All Indigenous, all girls.

Kathryn: Oh wow that's brilliant.

Melanie: And their whole focus was, ‘we want to inspire girls to think about being engineers and designers and being interested in this and we also want people to know that our cultural knowledge has a part to play in what we're doing’. So all their branding and their message was all sort of culturally woven in. It was extremely inspiring.

Kathryn: One of the things I, not struggled with, but had to put a lot of effort into was learning how to write a good rubric for Engineering because it's been different to Science. Like I’d never written for a design subject before, so that's one of the things, like I'm quite pleased with how, they're still improving, but I quite like how the rubrics are set out now. And that's one of the things that I want to kind of put out there and see if other people can find ways to improve –

Steve: Do the kids get those rubrics beforehand?

Kathryn: Yeah, they do.

Steve: Are they warranting their work?

Kathryn: So, I’ve actually begun, in the last year, getting them to fill in the rubric when they submit their thing, because otherwise they don’t read them – like you provide them but they're like, ‘oh, it's like a big page of text [ripping sound].’ So yeah, even going through it with them in class they won't retain it, but if I make them fill it in for themselves, like rate themselves, then they actually have to read it and then they don't miss stupid stuff, like, ‘there’s a line on the rubric for that and you just missed I entirely’.

Steve: I've worked with schools that have done as a bit of an accounting exercise, they say, ‘well, we're going to borrow this achievement standard or this aspect of your Maths, we’ll teach it in Science’ and so on and so forth, they'll swap it back and forward like that. And so it becomes a bit of a challenge because then you sort of have to take this evidence and put it over into Maths and you got to make sure that what they're assessing is really matching up to the standards you expect.

Kathryn: Oh I love that. Yeah. And I think there's been a bit of grumping about the MYP because it feels like it's what we do already and it's just a bunch of administration on top of it. On a bad day that's what it feels like. But I think, I think, most people are kind of approaching it as a sort of an opportunity to maybe try something new. So, yes, what we're doing is good, but certainly one of the things we haven't done particularly well is the interdisciplinary assessment task and there are just so many cool opportunities for doing, you know, cross-disciplinary stuff. So, if it's made a requirement then people actually have to get out there and just do it, so we don't waste those ideas.

Melanie: And when you were talking about that it really felt like a beautiful transition from what your thinking has been into what will be part of the established practice of the school.

Kathryn: Where was the- because there are lots of F1 in Schools competitions right?

Melanie: That particular one was run out at UNSW, oh sorry no, not UNSW, University of Western Sydney.

Kathryn: Oh yeah, cool. Yeah, so I looked at that as a potential kind of project for us, but I- I don't know, I think I was a bit scared off by the- one of the schools that I talked to that had done it had some really schmick kind of CLC laser cutters and I'm like, 'oh, we don't have that'. So yeah, I don't know. How do they – I don't know enough about how the kids make the cars.

Melanie: Well, I'm also going to be judging in December the Space in Schools competition.

Kathryn: Right. Which is a spinoff, and there's the Submarines in Schools-

Melanie: There's a whole bunch of different ones. The way it works is actually really quite lovely because the judges are drawn from academia, they have people from the Navy, they had industry engineers, they had educators like me and various other people, and then there's all these different categories the kids get judged on – there's a marketing component where they have to do a trade display and they have to brand their uniforms and they have to brand their vehicles or whatever they're doing, they have to seek sponsorship, so they have to sort of employ enterprise skills and write letters to people and contact printing firms and figure out who they can work with. And component that I was judging was the student verbal presentations, where they come and they talk about, each team member has to speak, and some of the kids are so painfully shy, they're literally –

Kathryn: Oh yeah, I believe you.

Melanie: – in front of the judges. And some of them are just really on point, but they get marks for every team member contributing, they get marks for explaining the technical process that they went through. And not all schools are created equal, so they're not necessarily judged on the quality of the equipment that they've got access to.

Kathryn: Yeah, right. What is the space in schools? What do they have to build for that?

Melanie: I'm not entirely sure because it's the first year I've judged it. But it is, look it is very interesting and hearing the kids, because part of the verbal component is getting them to talk about what they learned in the process and they say things like – because there's a marketing team member who's in charge of contacting all the printing firms and the marketing firms and they do exactly what you did on a student level, where they'll draw on a parent or an auntie or somebody that works in a local business or an engineer that came to the school that they contacted for help, so some of them will actually go to these onsite visits and get help with working out because they don't have the machinery at school.

Kathryn: Yeah, right.

Melanie: So that'll be part of their presentation, 'we didn't have this stuff so what we did was we contacted this local person who was only too happy to help us work through our designs and workshop it'. And some of them will say, 'I had no idea how to write to people, how to contact people, how to make those industry connections and I feel really confident and I'd like

to go into communications', or other people talk about, 'I had no idea how to use CAD and I had to go find somebody to help me work out how to do it and this particular teacher was crucial or my uncle Steve works in this industry and he gave me a contact for a person'.

Kathryn: That's cool.

Melanie: It's just so –

Kathryn: What's the team size?

Melanie: Most of them were about four or five/

Kathryn: Interesting.

Melanie: Yeah, it was really interesting. And what's really interesting too is that there's a team leader. The team that won that particular competition had never competed before and their team leader was a girl and all the other team members were guys, but she, one of the things that she said in her presentation was, 'I knew nothing about designing cars or engineering or any of this sort of thing, but what I've worked out is team management and the guys that are part of the team have taught me how this works and how they plan it and design it, and what we've done is build collective knowledge together and worked as an interdisciplinary team'.

Kathryn: Nice.

Melanie: There's a component where they have to talk about project management and how they organise that and how they collaborated together. And yeah it's really exciting as an educator to think there are schools that are encouraging these kids to be part of this competition to see what the bigger picture looks like and it's another version of STEM.

Kathryn: That's awesome. We have a minor issue for next year, which is that not enough of this year's Year 9s chose Engineering for Year 10 for the school to justify a class, so I've got a small bunch who did choose it who are like, 'oh it's not fair!' So maybe we should run that as a kind of- they can do it as an extracurricular and that way they can kind of keep their hand in and they can work together.

Melanie: And actually that would help them, because if they're working with various teachers who are and they don't have a specific subject that they're doing it through, that would bode well for them in the judging of the competition. They also have to do a design portfolio, so there's judges who just judge that part and that has to obviously be explicitly laid out, then there's the presentation component, then there's a marketing component and that's judged by people who work in marketing and communications, so they give them –

Kathryn: So we could do it as a little collaboration between a number of teachers. I can go and get the graphic design teacher, the Business Admin. teacher, yeah.

Melanie: And bring in some of those people from the community and parents who have contacts and the students are encouraged to contact people in university that they don't know and find out who else can help them teach them things, because there isn't the expectation that you'll be an expert in these areas, a lot of the kids say in their presentations, 'I had no idea what I was getting myself into but I've learned an incredible amount about working in a team

and things that can go wrong and I had to learn how to use CAD and I had to, we had to collaborate online because one of our team members was sick, so we created an online portal and we put all our stuff there', and you just kind of think you know –

Kathryn: Yeah, that is valuable.