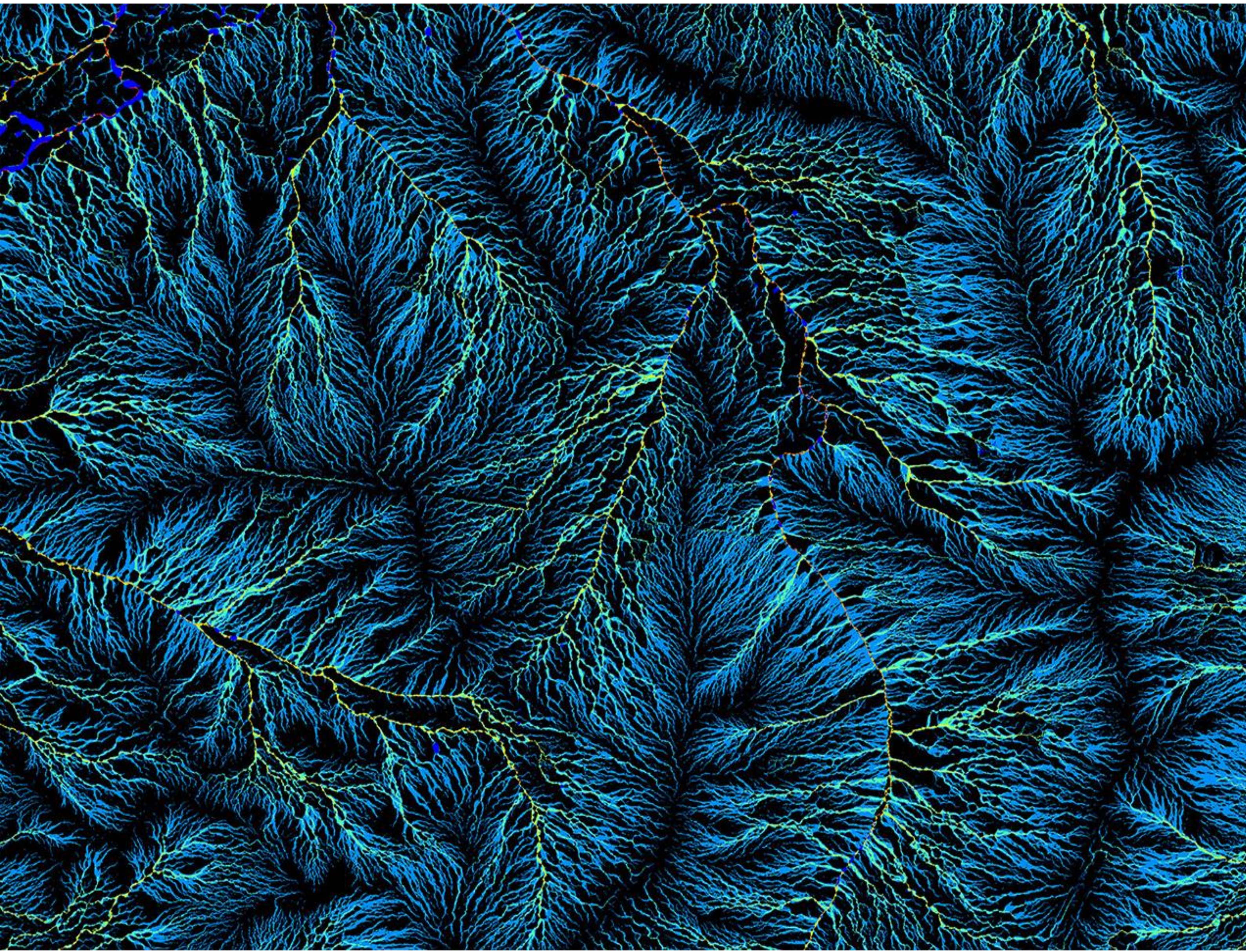
Insights Report: 2021

Generation STEM, STEM Community Partnerships Program

Written by the Impact and Evaluation Team, Education and Outreach

March 2022



Introduction

This 2021 Insights Report was developed by the CSIRO Education and Outreach Impact and Evaluation Team (I&E team) and aims to provide key stakeholders with a snapshot of evidence[1] about the implementation and effectiveness of the Generation STEM program. At the time of writing this report, the **STEM Community Partnerships Program (STEM CPP)** was the only program fully operational under the Generation STEM initiative and therefore this report is solely focused on reporting the outcomes of STEM CPP. In future years as more programs become operational, the report with be divided up into the three focus areas: 1) building the STEM pipeline at school 2) transition to employment and 3) retention in STEM.

Every effort has been made to ensure the accuracy of the findings presented in this report. However, given its interim nature and other constraints inherent with the methodologies, some caution should be exercised when interpreting and generalising findings in this report.

Executive summary

This report is based on the **data available** for STEM CPP as of January 2022. It draws on:

- survey data gathered at the end of 2021, representing the views and experiences of 112 students, 8 teachers and 4 council staff.
- post-event questionnaire data gathered throughout 2021, representing the views of 27 students, and 138 teachers, industry, and council staff.
- qualitative data from 5 interviews with teachers and industry supervisors.

To date, the I&E team have not gained access to student-level data from the NSW Education Standards Authority (NESA) nor the NSW Department of Education (the Department). This is due to several factors, including the impacts of COVID on the workloads of the relevant units within NESA and the Department, and the significant privacy requirements related to the transfer of student-level data between government agencies. However, given the long-term timeframe between exposure to the program and impact on students' subject selection and Year 12 attainment, this is not an issue for this current stage of the evaluation.

Findings from the surveys, interviews and post-event questionnaires indicate initial positive results for STEM CPP. **Key insights** include:

- students' self-reported interests and attitudes towards STEM have substantially increased over the 2021 school year
- the inquiry-learning project appears to be having the biggest impact on students' interest in STEM
- most students reported that they felt confident about doing well in their STEM subjects
- female students are less likely than male students to report being confident about STEM, and to have a desire to work in STEM
- students and teachers report that STEM CPP has positively impacted students' 21st Century skills.

The **implementation of STEM CPP** has faced a number of challenges, especially with the impacts of COVID. Key barriers to date have included:

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[1] It should be noted that previous years' data was not sufficient for comparative purposes. However, future years will include comparisons to the baseline data collected in 2021.

- the postponement of activities and specific industry partnerships
- the transition to online delivery for a number of key student activities
- delayed engagement with schools and industry mentors, resulting in less-than-ideal collaborations between schools and industry partners
- a burdensome consent process for schools and parents.

Despite these barriers, participating schools and industry mentors alike spoke positively about their experience with STEM CPP and are keen to remain involved in the program. For many schools, the student-led approach to solving local community problems has engaged students considerably in the STEM inquiry-learning process.

A key recommendation is to focus on further building relationships and processes with industry so schools can more effectively plan for activities in the school year. This clarity will also help with streamlining of the consent process and will strengthen relationships between schools and industry mentors.

Key program insights

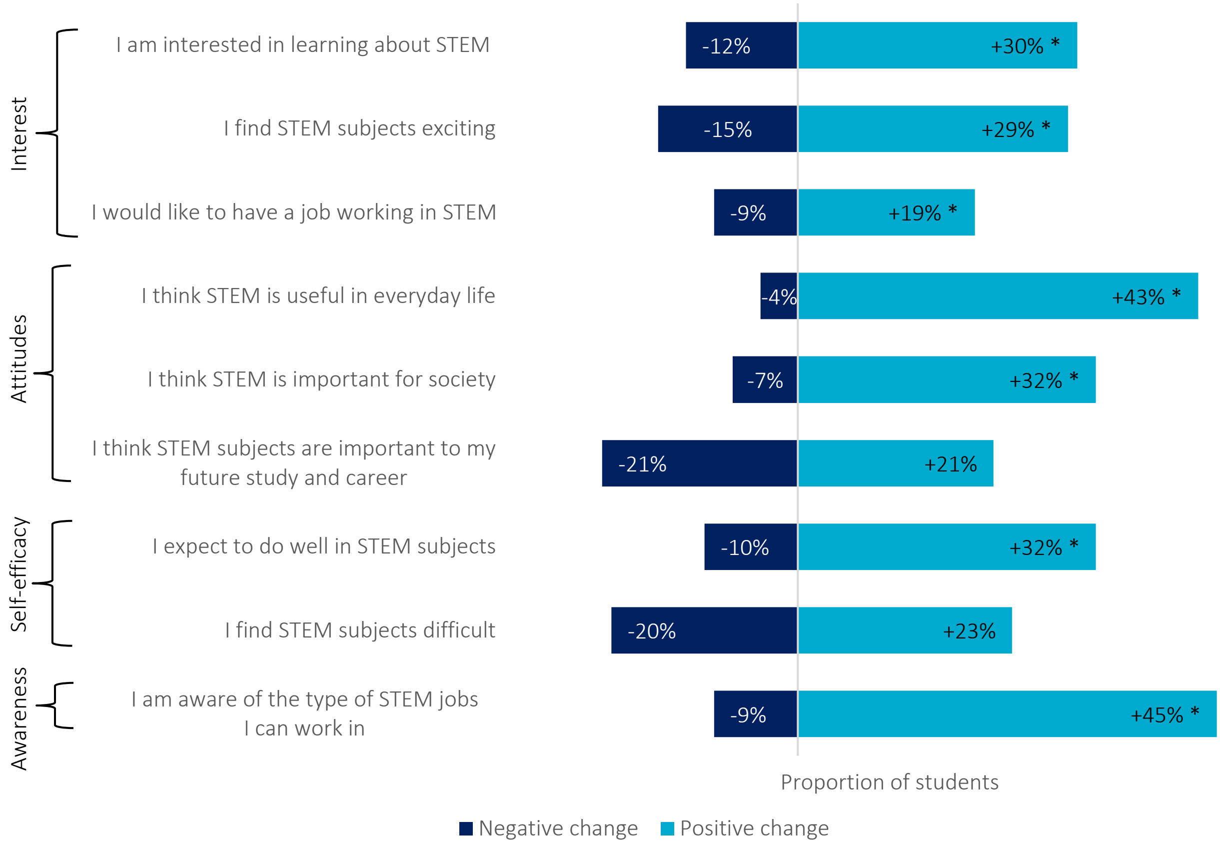
Given the interim nature of this this report, the I&E team have presented the findings by key themes arising from the main student survey – supported by other survey, questionnaire and interview data collected in 2021. Again, as more Generation STEM programs become fully operational, data will be analysed against main focus areas and success measures.

Students' interest and attitudes towards STEM have significantly improved

One of the main goals of STEM CPP is to improve students' awareness, attitudes, and interest in STEM, which in turn, is anticipated to lead to a greater aspiration among students to further study and work in STEM.

The student survey asked respondents what they thought about a number of key statements[2] regarding STEM both at the *start* of the school year (asked retrospectively), and at the *end* of the school year (after taking part in STEM CPP). Analyses of the data show that **students self-reported a statistically significant positive change in seven out of the nine statements** (see Figure 1). The largest changes related to the proportion of students self-reporting a positive shift in their **awareness** about the type of STEM jobs they could work in (45 per cent), and their **attitude** about STEM being useful in everyday life (43 per cent).

Figure 1: Students' self-reported change in interest and attitudes about STEM, 2021



Note: * Wilcoxon Signed Rank Test indicates statistically significant difference at $p < .05$ level. The 'finding STEM subjects difficult' option was re-coded to align with the positive wording of the other options; that is, the proportion of participants are those who felt STEM subjects were less difficult at the end of the school year.

[2] This list of statements was selected from a range of international and domestic studies measuring student interest in, attitudes about, and self-efficacy in STEM. The items were selected (and sometimes adapted) because they were commonly used in survey instruments to build student interest indexes.

Additionally, students completing the post-event questionnaire after their virtual work experience (n = 27) also strongly agreed (44 per cent) or agreed (6 per cent) that they were more **likely to study** STEM after completing their virtual placement. Similarly, 44 per cent agreed or strongly agreed that they were more **interested** in learning about STEM.

It is important to note that because it was not feasible to survey students who did not participate in STEM CPP (i.e., a comparison group), the I&E team cannot definitively determine to what extent this positive change in interest and attitudes in the main student survey are directly attributable to STEM CPP. These results are only indicative of the program's initial impact as derived from the self-reports of participants and will be supplemented by student-level subject selection and HSC completion data in future years.

Female students are less confident about STEM than males, and less likely to report a positive change in their interest to work in STEM

Overall, the majority of students surveyed felt confident about the key STEM subjects (science, mathematics, and technology) they were studying in Years 9 and 10. However, compared to male students, **female students were less likely to report that they felt confident about all STEM subjects,** although only the differences in Technology, iSTEM, and STEM-related VET subjects were statistically significant (Table 1). These findings align with domestic and international research regarding females' self-efficacy in STEM[3]. Interestingly, this gap in confidence did not appear to influence the number of female students wanting to study STEM in Years 11 and 12, with **little difference between the proportion of male and female students stating that they would be studying STEM subjects in Years 11 and 12**.

Table 1: Students who reported feeling 'confident' studying STEM by subject and gender, 2021

Year 9 and 10 STEM subjects	Female students n = 36–49	Male students n = 46–58	All students n = 116
Science	60%	77%	69%
Mathematics	54%	64%	59%
Technology subjects*	48%	72%	59%
iSTEM*	33%	62%	49%
STEM-related VET subjects*	14%	44%	30%

Note: Survey scale options comprised: not confident, somewhat confident, and confident. * statistically significant difference between female and male students at $p < .05$ level (chi-square test of independence).

In addition, **female students were also less likely than their male counterparts to say that they would like to have a job working in STEM** (45 per cent compared to 62 per cent for males).[4] This is despite reporting a more significant positive change in their 'interest in learning about STEM' than male students (item 1, Figure 1), and placing a high value on the importance of STEM in society. While these data are from only a sample population of STEM CPP participants, it is worthwhile for the Generation STEM program team to

[3] Results from both TIMSS and PISA 2015 show that male students in Australia have substantially higher levels of self-confidence and self-efficacy in both mathematics and science than female students. See *TIMSS 2015: A first look at Australia's results* [available from www.acer.edu.au/timss], and *PISA 2015: A first look at Australia's results* [available from wwww.acer.edu.au/ozpisa].

[4] The Wilcoxon Signed Rank Test for the question 'I would like to have a job working in STEM' indicated that male participants had a statistically significant increase after participating in STEM CPP ($Z = -2.2434$, $p = 0.0251$), while female participants did not show a statistically significant increase ($Z = -0.2272$, $p = 0.8181$).

keep these gendered results in mind when designing and planning activities, materials, and recruiting industry mentors.

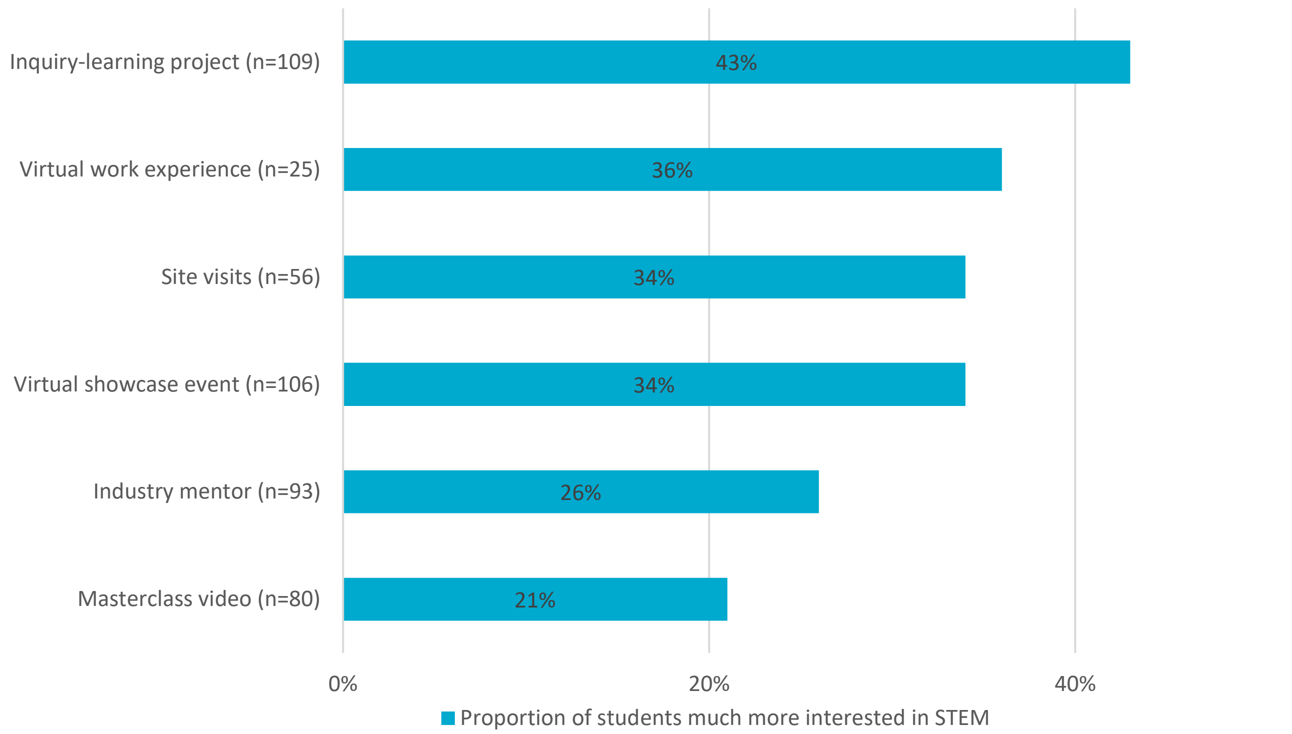
Teachers were asked in their survey what barriers prevent students from continuing with STEM in upper high school. Most cited a lack of ability among students to link STEM with real-life, and long-term career goals. One teacher mentioned girls' lack of confidence in their abilities:

> *Sometimes* [students] *don't see how* [STEM] *is useful for them, and some students, mainly girls, do not take risks in their learning and see STEM subjects as 'too hard' even when they are capable.*

The inquiry-learning project appears to be having the greatest impact on students' interest in STEM

Students were also asked to rate what impact STEM CPP activities had on their interest in STEM. Compared to other activities, **students were more likely to report that participating in the inquiry-learning project had made them 'much more interested in STEM'** (43 per cent, see Figure 2). These results make sense with the main focus of STEM CPP being on the inquiry-learning project, and a number of other activities supporting different elements of the inquiry-learning project. In contrast, students were half as likely to say the masterclass video had a significant impact on their interest in STEM (21 per cent 'much more interested').[5]

Figure 2: Impact of individual STEM CPP activities on students' self-reported interest in STEM, 2021



These student survey results are supported by the teacher survey and interviews conducted with other classroom teachers and industry mentors. Over half (57 per cent) of the teachers surveyed (n = 7) stated that the inquiry-learning project had a significant impact on their students' interest in STEM. Teachers and mentors who were interviewed (n = 5) also generally felt that the **scaffolding of the inquiry-learning**

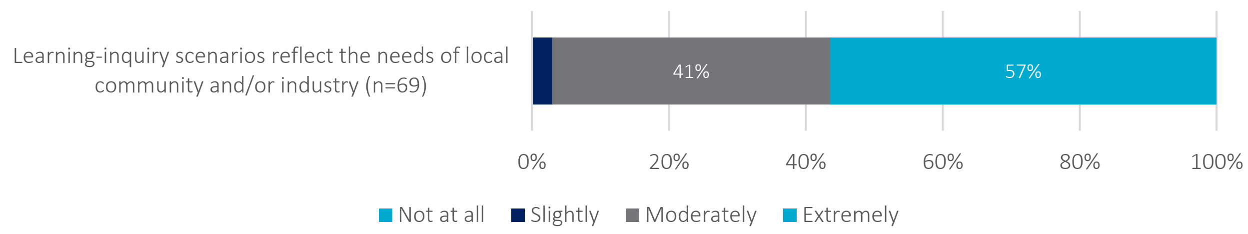
[5] A chi-square test of independence was conducted comparing female and male students, and CALD and non-CALD students, on the questions related to activities and interest in STEM. There were no statistically significant differences on any questions.

project, with its student-led focus, had helped engage students in the STEM design process. The structure allowed students to develop their problem solving and critical thinking skills without being overwhelmed and encouraged them to find solutions to real-life problems faced by their community. An industry mentor noted:

> *It's really good to bring them along and make them believe in the project that they're doing. I found that resonated with the students as well. Like, when they presented their ideas, it was a real-world problem and this was their solution, and they really believed in the process that they had come up with to that problem. I thought that was quite powerful, actually.*

Another positive aspect of STEM CPP is that the challenge scenarios developed for schools' inquiry-learning projects reflect both council and industry's local needs. In a post-event questionnaire (n = 69) the majority of council and industry workshop attendees (57 per cent) stated that the challenge scenarios were 'extremely' reflective of the needs of their local community, while another 41 per cent reported that the scenarios did so to a moderate extent (Figure 3). Only a small proportion of respondents (three per cent) reported 'slightly'.

Figure 3: Extent to which learning-inquiry project scenarios reflect local council and industry needs, 2021



There were also some challenges associated with the inquiry-learning project, including the matching of industry mentors with schools. Data from the student survey about each of the STEM CPP activities indicates that the impact from matching industry mentors with schools (Figure 2) has not been as strong as other elements of the program. While interviews with teachers and industry mentors highlighted the value of having a STEM professional engage with students, a number of participants stated that the **delays in matching industry mentors with schools had reduced the level of influence and effective support they could provide to schools and students**. One teacher participating in the program stated:

> *The industry mentor was connected with the school very late into the project and did not provide much support for students with their projects. It would be beneficial for them to be connected earlier and to be more involved.*

Additionally, there may need to be more consideration given to the process of matching industry mentors with the inquiry-learning project topic chosen by each school. One teacher interviewed stated that they did not use the industry mentor they were matched with because the mentor worked in a STEM industry not aligned with the inquiry-learning topic being completed in-class. Instead, the teacher connected the industry mentor with another class in their school not participating in STEM CPP. An industry mentor cited similar issues when trying to find the appropriate staff to link with schools based on their professional expertise and the inquiry-learning topic being completed.

Finally, to support positive student learning outcomes, a number of teachers and mentors surveyed and interviewed felt it was important for STEM CPP stakeholders to **provide students with feedback on their**

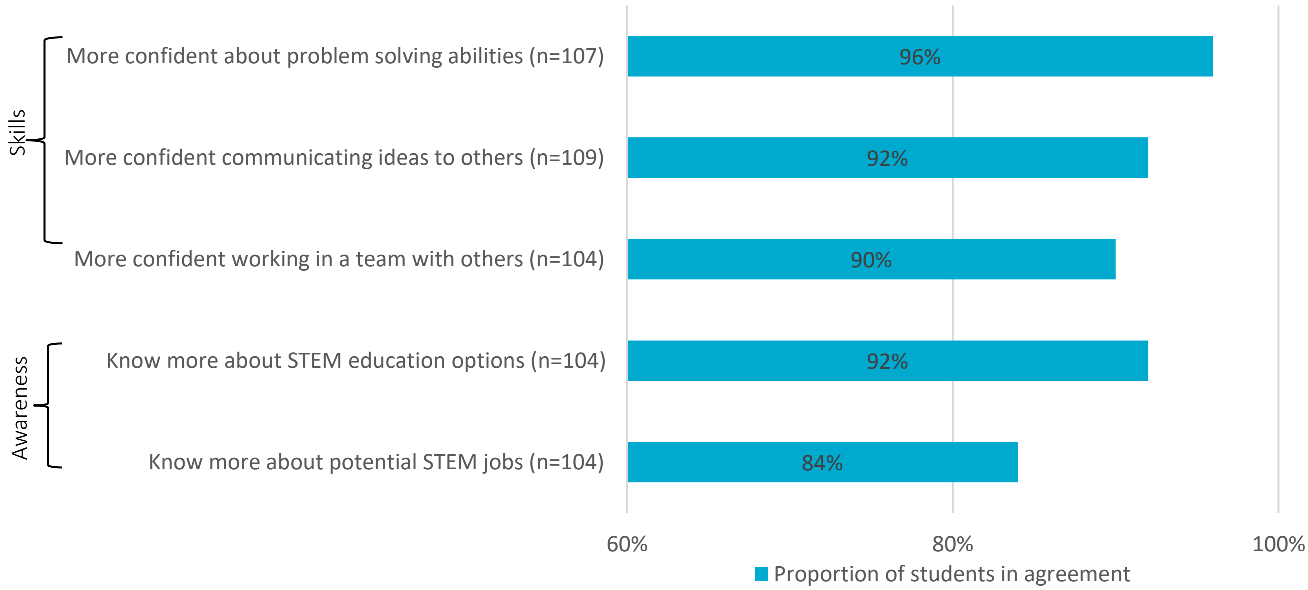
inquiry-learning projects after participating in the showcase event. One teacher surveyed emphasised that:

> *...they* [students] *felt as though they had put a lot of work in and only received feedback from our class teachers.*

STEM CPP is positively impacting students' skills and awareness

The survey and interview data indicate that STEM CPP is having a positive impact on students' skills and awareness. **Nearly all students reported that they felt more confident about certain 21st century skills[6] as a direct result of participating in STEM CPP** (Figure 4).[7] Students were similarly in agreement about STEM CPP helping them know more about STEM education options available to them (92 per cent). Interestingly, while students self-reported the greatest positive change in their awareness of STEM jobs (last item, Figure 1), they were less likely to attribute this improvement directly to STEM CPP compared to other items (84 per cent, Figure 4). However, it is important to recognise that not all elements of STEM CPP can have equally strong impacts on participants, and 84 per cent of students agreeing they know more about STEM jobs as a result of STEM CPP is a positive result in its own right.

Figure 4: Impact of STEM CPP on students' self-reported skills and awareness of STEM, 2021



Aligning with data from the student survey, **teachers who were surveyed perceived that their students' skills had increased as a result of participating in STEM CPP**; this more-so than their awareness of STEM education and career pathways. In particular, 83 per cent (n = 5) stated that their students had substantially improved how they creatively thought about ways to solve problems. The two teachers interviewed in the 2021 case study (see Appendix B: St Paul's Grammar School case study) were also impressed by how well their students communicated with their industry mentor – stating that this, along with knowing that they may have to present their inquiry-learning project to council and CSIRO, had provided students with real purpose. One teacher stated:

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[6] In Australia, 21st century skills are commonly recognised as being 'ways of thinking' (critical and creative thinking, problem-solving skills), 'ways of working' (communication and teamwork skills), 'tools for working' (ICT literacy) and 'ways of living' (personal and social responsibility).

[7] A chi-square test of independence was conducted comparing responses of females and males, and CALD and non-CALD students. There were no statistically differences on any questions.

Seeing the students have a conversation with a professional, I was quite taken aback actually. I think back over the last 5 years, I've never had a moment like that, where I think, oh, my goodness they have actually taken all of this on and I can speak about the process that they've gone through, and why they've come up with particular ideas and backed it with research. And I think the mentor was honestly quite shocked as well. I can't believe these 12–14-year-old kids have just pitched these ideas to me, it was a really cool experience.

Conclusion and recommendations

Overall, data from the surveys and interviews indicate that STEM CPP has been well received by stakeholders participating in the program, with most council staff[8], teachers and industry mentors indicating they are likely to continue with STEM CPP into 2022. The program has provided schools with the opportunity to engage with community and industry in unique ways that may not have been possible otherwise. This has helped to expose students to examples of 'real-life' STEM beyond the standard classroom curriculum; and led to a significant increase in many students' interest, awareness, and attitude towards STEM.

While one of the key benefits of STEM CPP is that it can be adapted to each school's specific context and need, this can lead to challenges with its implementation. Given STEM CPP is in its first year of substantial growth, recommendations are targeted around its processes and continual improvement for future years:

1. Continue to **build on the successes** of the program in 2021, including delivering an effective inquiry-project that is contributing to an increase in students' 21st century skills, and an increase in their interest and engagement towards STEM.
2. Further explore **gendered differences** in student outcomes, and consider tailoring some portions of STEM CPP (and/or other Generation STEM programs) to address specific challenges that young women face when pursuing STEM education (e.g., low self-efficacy in STEM, lack of female role models).
3. **Consider the purpose and effectiveness of the pre-recorded masterclass videos** in the suite of STEM CPP activities. The purpose may need to be revised and/or better communicated to teachers and students, as it was the least likely to lead to increases in interest in STEM out of all the STEM CPP activities.
4. **Focus on matching schools with industry mentors earlier in the school year** so teachers can more effectively use them as a resource for their students during the entirety of the inquiry-learning project. This could be achieved by the continual strengthening of industry partnerships, and/or by having long-standing relationships between schools and industry mentors, so that existing industry mentors are ready to be matched and organisations providing new mentors are well-prepared to commence early in the school year.
5. **Review the current matching process undertaken for industry mentors and schools**. While it is important to maintain flexibility around the delivery of STEM CPP, there appears to be a need to better align industry mentors' expertise with the inquiry-learning topics being undertaken in schools. This should be addressed in conjunction with recommendation 4.
6. Explore viable options to **provide more personalised feedback to students** on their work in the inquiry-learning project. This could include having more formal feedback processes at the showcase event; incorporating a peer-to-peer feedback model; or supporting mentors in providing feedback to their classes. If these options are not feasible, for example because mentors already volunteer their own time to participate in STEM CPP, then better managing the expectations among students should be considered.

[8] 100 per cent (n = 4) of council staff stated they were 'very likely' to continue with STEM CPP.

Appendix A: Survey data

The full student survey results have only been included in this appendix, with the smaller among of data from the council, teacher, and post-event questionnaire referenced where necessary throughout the body of the report. Please note that ‘not applicable / hard to say’ responses have not been included in these analyses.

Student demographics

Intention to study at TAFE or university	Number	Proportion
Year 9	76	68%
Year 10	36	32%

Gender	Number	Proportion
Female	49	46%
Male	58	54%
Other / prefer not to say	0	0%

Aboriginal and/or Torres Strait Islander	Number	Proportion
Yes	1	1%
No	110	98%
Prefer not to say	1	1%

Culturally and linguistically diverse	Number	Proportion
Yes	52	46%
No	57	51%
Prefer not to say	3	3%

Student post-school destination

Intention to study at TAFE or university	Number	Proportion
No	2	2%
Unsure / don’t know yet	13	12%
TAFE, but unsure what to study	6	5%
TAFE, and know what to study	3	3%
University, but unsure what to study	44	39%
University, and know what to study	44	39%

Factors influencing student subject selection

What their parents and family think	Number	Proportion
No impact	29	26%
Slight impact	47	42%
Big impact	36	32%

What their friends are studying	Number	Proportion
No impact	59	56%
Slight impact	40	38%
Big impact	6	6%

How interesting they find the subject	Number	Proportion
No impact	2	2%
Slight impact	13	12%
Big impact	94	86%

How well they think they will do in the subject	Number	Proportion
No impact	5	5%
Slight impact	33	30%
Big impact	72	65%

Relevance of the subject to their daily life	Number	Proportion
No impact	6	6%
Slight impact	48	45%
Big impact	52	49%

Relevance to what they want to do for a job	Number	Proportion
No impact	2	2%
Slight impact	15	14%
Big impact	91	84%

Pre-requisites for TAFE or university	Number	Proportion
No impact	7	7%
Slight impact	29	29%
Big impact	64	64%

Which teacher is teaching the subject	Number	Proportion
No impact	30	29%
Slight impact	49	47%
Big impact	26	25%

Student confidence studying STEM subjects

Science	Number	Proportion
Not very confident	1	1%
Somewhat confident	33	29%
Confident	78	70%

Mathematics	Number	Proportion
Not very confident	8	7%
Somewhat confident	38	34%

Confident	66	59%

Technology subjects	Number	Proportion
Not very confident	4	4%
Somewhat confident	40	36%
Confident	67	60%

iSTEM	Number	Proportion
Not very confident	11	12%
Somewhat confident	36	39%
Confident	45	49%

STEM-related VET	Number	Proportion
Not very confident	13	16%
Somewhat confident	45	54%
Confident	25	30%

Student intention to study STEM subjects in Years 11 and 12

General mathematics	Number	Proportion
No	38	36%
Yes, potentially	24	22%
Yes, definitely[9]	45	42%

Advanced or extension mathematics	Number	Proportion
No	19	18%
Yes, potentially	27	25%
Yes, definitely	62	57%

Science subjects	Number	Proportion
No	7	6%
Yes, potentially	19	18%
Yes, definitely	82	76%

Technology subjects	Number	Proportion
No	28	27%
Yes, potentially	27	27%
Yes, definitely	47	46%

STEM-related VET subjects	Number	Proportion
No	46	48%
Yes, potentially	30	32%
Yes, definitely	19	20%

[9] This question option combines 'yes' and 'yes, definitely' from the Year 9 and Year 10 surveys.

STEM-related school apprenticeships or traineeships	Number	Proportion
No	49	52%
Yes, potentially	30	32%
Yes, definitely	15	16%

Change in students' interest and attitudes towards STEM[10]

I am interested in learning about STEM	Number	Proportion
Negative change	13	12%
No change	65	58%
Positive change	34	30% *
Effect sizes – All: 0.28; Females: 0.32; Males: 0.11; CALD: 0.08; non-CALD: 0.33		

I think STEM is useful in everyday life	Number	Proportion
Negative change	4	4%
No change	60	54%
Positive change	48	43% *
Effect sizes – All: 0.55; Females: 0.41; Males: 0.36; CALD: 0.37; non-CALD: 0.40		

I find STEM subjects exciting	Number	Proportion
Negative change	17	15%
No change	62	55%
Positive change	33	29% *
Effect sizes – All: 0.22; Females: 0.13; Males: 0.16; CALD: 0.07; non-CALD: 0.22		

I think STEM subjects are important to my future study and career	Number	Proportion
Negative change	23	21%
No change	66	59%
Positive change	23	21%
Effect sizes – All: 0.05; Females: 0.05; Males: 0.08; CALD: 0.09; non-CALD: 0.03		

I find STEM subjects difficult	Number	Proportion
Negative change	22	20%
No change	64	57%
Positive change	26	23%
Effect sizes – All: 0.02; Females: 0.04; Males: 0.03; CALD: 0.02; non-CALD: 0.01		

I think STEM is important for society	Number	Proportion
Negative change	8	7%
No change	68	61%

[10] An effect size was calculated for each Wilcoxon Signed Rank Test. Effect sizes indicate how meaningful the difference in self-reported interest and attitudes are. Effect sizes range from 0.0 to 1.0. Cohen suggested that an effect size of 0.2 was small, 0.5 was medium, and 0.8 was large. The effect size for a Wilcoxon Signed Rank Test was calculated using the formula: Z / √N, where N was the number of observations (not respondents).

Positive change	36	32% *
Effect sizes – All: 0.42; Females: 0.38; Males: 0.29; CALD: 0.30; non-CALD: 0.36		

I am aware of the type of STEM jobs I can work in	Number	Proportion
Negative change	9	9%
No change	53	47%
Positive change	50	45% *
Effect sizes – All: 0.47; Females: 0.29; Males: 0.37; CALD: 0.35; non-CALD: 0.33		

I expect to do well in STEM subjects	Number	Proportion
Negative change	11	10%
No change	65	58%
Positive change	36	32% *
Effect sizes – All: 0.34; Females: 0.17; Males: 0.34; CALD: 0.25; non-CALD: 0.23		

I would like to have a job working in STEM	Number	Proportion
Negative change	10	9%
No change	81	72%
Positive change	21	19% *
Effect sizes – All: 0.25; Females: 0.03; Males: 0.29; CALD: 0.06; non-CALD: 0.25		

Impact of STEM CPP activities on students' interest in STEM

Completing inquiry project	Number	Proportion
Less interested	4	4%
No change in interest	17	16%
A bit more interested	41	38%
Much more interested	47	43%

Interacting with industry mentor	Number	Proportion
Less interested	5	5%
No change in interest	26	28%
A bit more interested	38	41%
Much more interested	24	26%

Watching masterclass video	Number	Proportion
Less interested	7	9%
No change in interest	25	31%
A bit more interested	31	39%
Much more interested	17	21%

Attending business site / workplace	Number	Proportion
Less interested	1	2%
No change in interest	13	23%
A bit more interested	23	41%

Much more interested	19	34%

Participating in the virtual showcase	Number	Proportion
Less interested	6	6%
No change in interest	22	21%
A bit more interested	42	40%
Much more interested	36	34%

Participating in virtual work experience	Number	Proportion
Less interested	0	0%
No change in interest	6	24%
A bit more interested	10	40%
Much more interested	9	36%

Impact of STEM CPP activities on students' skills and awareness

More confident working in a team with others	Number	Proportion
Strongly disagree	3	3%
Disagree	7	7%
Agree	45	43%
Strongly agree	49	47%

More confident communicating ideas to others	Number	Proportion
Strongly disagree	2	2%
Disagree	7	6%
Agree	47	43%
Strongly agree	53	49%

More confident about problem-solving abilities	Number	Proportion
Strongly disagree	2	2%
Disagree	2	2%
Agree	47	44%
Strongly agree	56	52%

Know more about STEM education options available	Number	Proportion
Strongly disagree	2	2%
Disagree	6	6%
Agree	53	51%
Strongly agree	43	41%

Know more about potential STEM jobs	Number	Proportion
Strongly disagree	3	3%
Disagree	14	13%
Agree	50	48%
Strongly agree	37	36%

Appendix B: St Paul's Grammar School case study

Introduction

This case study describes how St Paul's Grammar School has started incorporating the STEM Community Partnerships Program (STEM CPP) into its secondary school academic program to help increase student interest in STEM, and encourage further participation in STEM subjects.

Background

St Paul's Grammar School profile

Years:	K-12
Type:	Co-educational
Sector:	Independent
Location:	Penrith LGA
Size:	840 students
Diversity:	1% Aboriginal and/or Torres Strait Islander students 20% students with language other than English
ICSEA:	1116

Students in early and middle secondary school are required to study both the International Baccalaureate Middle Years Programme and the NSW Education Standards Authority (NESA) curriculum. In senior school, students then have the option to complete either the Higher School Certificate (HSC) or International Baccalaureate (IB).

Over the past few years, St Paul's Grammar School has moved towards further enhancing students' STEM skills and interest in the classroom and is now starting to consolidate this progress by participating in several externally developed STEM education programs.

School engagement

St Paul's Grammar School signed up to STEM CPP in early 2021, with one Year 9 and one 10 Design and Technology class participating in the program under the supervision of classroom teachers, Nick Storm and Erika Baudinet. Nick and Erika's Head of Learning was key in the decision-making to participate in STEM CPP.

Due to COVID-19 and scheduling conflicts, students only participated in the inquiry project – which includes being matched with an industry mentor. While the teachers were disappointed that their students did not have the opportunity to engage in other STEM CPP activities, they felt that this disruption had allowed them to more effectively incorporate the inquiry project into their curriculum and teaching program for the first time.

> *'I think it was probably easier than being bombarded… it was nice for* [the students] *just to progress through at their own pace.' – Erika, teacher*

In Term 3, St Paul's Grammar School was matched with David Fulker, an industry mentor from Stryker – a multinational medical device company with offices in Australia and New Zealand. David currently leads the clinical trials of medical devices within Stryker's Clinical Research Division, and has been in this role for the past four years. Stryker has a strong history of being involved in community and STEM education outreach initiatives.

Implementation

Inquiry topic

Students from both Years 9 and 10 classes worked in small groups to complete their inquiry projects on the issue of flood mitigation. This topic was selected by the teachers, who felt that their students were more likely to engage with this problem due to previous flooding events in the local area, and the school's proximity to Warragamba Dam. The inquiry project was incorporated into the Design and Technology class program over eight weeks.

Curriculum links

Both teachers felt the structure of the inquiry project worked well with their IB curriculum, and that it was easily incorporated into their school's established inquiry 'design' cycle. The stimulus pack provided to the school as part of STEM CPP helped provide the teachers with scaffolding for the first step of this design cycle process. While only two inquiry projects were selected from both year groups for the end-of-year virtual showcase event, all students were required to record and submit a two-minute presentation to their teacher about the project. These presentations contributed to their final school grades.

> *'Our design cycle just fits really well with the inquiry project. We didn't have to massage things too much for it to work with our school context.' – Nick, teacher*

Inquiry-based learning

St Paul's Grammar School has a strong focus on inquiry-based learning due to its IB curriculum; with Erika and Nick stating they regularly incorporate this teaching method into their classroom programs. While both teachers felt confident teaching Design and Technology through inquiry-based learning, neither had done so in such a student-led way. They stated that attending the teacher professional learning day, coupled with the structure of the inquiry project, had empowered them to deliver student-led inquiry-based learning in their classrooms.

Mentor support

David, the industry mentor, supported the teachers with their materials, and met with a number of students, providing them with individual feedback on their inquiry projects. David also presented virtually to both year groups about how best to take design concepts to market and convince stakeholders that their ideas are worth pursuing and implementing in the community. In the future, he plans to provide feedback to all students – even those who did not present their projects at the virtual showcase event.

> *'I didn't necessarily draw on the technical aspects of my STEM background, it was more based on my industry experience and relaying what happens in real-life to the students.' – David, industry mentor*

School outcomes

School expansion

Both teachers were overwhelmingly satisfied with STEM CPP, and intend to continue with the program into 2022, and extend it to their other Design and Technology classes. Other STEM teachers at St Paul's Grammar School have also expressed interest in being involved with STEM CPP moving forward. Another indication of the program's success is that both Erika and Nick plan to incorporate the inquiry project into their full 12–week school term, and use this student-led inquiry approach for other in-class projects.

> *'We had only anticipated 8 weeks for this project, but we now realise that because it was such a great experience for everybody, it's going to be built into the programming, so it goes for the full semester.' – Erika, teacher*

Student engagement

The teachers felt that the scaffolding of the inquiry project, with its student-led focus, really helped engage students in the design process. The structure allowed students to develop their problem solving and critical thinking skills without being overwhelmed; and it encouraged them to find solutions to real-life problems faced by their community. David echoed the teachers' comments, highlighting the value of this type of program for secondary school students.

> *'It's really good to bring them along and make them believe in the project that they're doing. I found that resonated with the students as well. Like, when they presented their ideas, it was a real-world problem and this was their solution, and they really believed in the process that they had come up with to that problem. I thought that was quite powerful, actually.' – David, industry mentor*

Student skills

The teachers also identified that their students benefitted from working together as a team on the inquiry project, especially given that Design and Technology project work is usually completed individually. In particular, Erika and Nick were impressed by how well their students communicated with their industry mentor – stating that David's involvement, and knowing that they may present their inquiry projects to council and CSIRO, had provided students with real purpose.

> *'… when the students presented back to council* [virtual showcase]*, they really considered some adult themes in their design process. Some of them had elements that they recognised were going to be scrutinised from an ethical standpoint, like the genetic modification of plants... I was really impressed.' – David, industry mentor*

Observations

It is clear that being matched with an industry mentor and being involved in the virtual showcase event provided St Paul's Grammar School with a unique opportunity to interact with industry professionals and the wider community. This, coupled with the student-led focus of the inquiry project, has helped engage students in STEM and allowed them to see its application in a real-life context.

School success factors

The structure of the IB curriculum has greatly helped facilitate the school's implementation of the inquiry project into the Stage 5 Design and Technology curriculum; with few changes needed to incorporate the project into the regular class program. Additionally, Erika and Nick are engaged teachers who are passionate about making STEM interesting for their students. This coupled with the fact that both teachers have actively supported each other to implement STEM CPP, looks to be a key reason for the program's success in St Paul's Grammar School. The teachers also emphasised that their principal was very supportive of STEM CPP.

> *'… At the beginning I was maybe a little bit hesitant to see how it was going to go. But honestly, the students really took it and ran with it. So we're quite excited to see where this is going to lead in the next few years.' – Erika, teacher*

Matching mentors earlier

As mentioned previously, both Erika and Nick highlighted the considerable value gained from having a STEM industry professional engage with their students. While interactions between the industry mentor and students were overwhelmingly positive; David was only matched with St Paul's Grammar School in Term 3, which was late in the school's implementation of the inquiry project. This meant there was limited time available for David to fully engage with the teachers, and to provide meaningful feedback to students about their projects during the design process. Moving forward, schools should be matched with industry mentors earlier in the school year to better leverage these relationships, and for this process to be more clearly communicated to schools so they can plan their programs more effectively.

Providing a communication framework

Finally, while David had considerable experience teaching and mentoring university students, he noted there was a significant shift in the way he had to engage and communicate with school-aged students. The STEM CPP program team might consider providing industry mentors with more guidance on how best to interact with school-aged students, along with a framework about how best to engage and support teachers.

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