THE UNIVERSITY OF QUEENSLAND
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An Evaluation Framework for STEM Enrichment Programs

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SMI CSRM
Centre for Social Responsibility in Mining

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Acronyms and Key Terms

CSRM	Centre for Social Responsibility in Mining
DDSW	Darling Downs South West, Queensland, Australia
DETE	Department of Education, Training, and Employment, Queensland

SoW	Scope of Work
SSP	STEM Schools Partnership
STEM	Science, Technology, Engineering and Maths
QLD	Queensland, Australia
Coordinating agencies:	Program sponsors, DETE, schools involved in the SSP.
Program sponsors:	Companies from one resource industry funding the SSP.
The region:	Darling Downs South West, Queensland (DDSW).

Disclosure

The UQ, Centre of Coal Seam Gas is currently funded by the University of Queensland 22% ($5 million) and the Industry members 78% ($17.5 million) over 5 years. An additional $3.0 million is provided by industry members for research infrastructure costs. The industry members are QGC, Santos, Arrow and APLNG. The centre conducts research across Water, Geoscience, Petroleum Engineering and Social Performance themes.

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The Australian Code for the Responsible Conduct of Research outlines expectations and responsibilities of researchers to further ensure independent and rigorous investigations.

This report has not yet been independently peer reviewed.

Document Control Sheet

Version #	Reviewed by	Revision Date	Brief description of changes
1	Elizabeth Alcantarino	08/02/16	Change report template and formatting

Executive Summary

The Context

Enrolment in school subjects in science, technology, engineering and mathematics (STEM) has been declining over the past 10 to 15 years, both in Australia and in many developed countries around the world. Enrichment programs in STEM have been pursued as one avenue to maintain student interest in science as they progress. A question arises – for a given investment, which programs provide the greatest impact?

To help answer this question, our UQ research team developed an evaluation framework. The framework is based on a 'program logic' approach to link overall aims with specific outcomes. We have synthesised international literature to identify suitable aims for an enrichment program at each year level in school.

Our analysis and formulation were completed with respect to the needs of our research sponsors, who were supporting enrichment programs in a rural area. That is an important parameter, as enrichment programs tend to be more available for students in urban and suburban areas than they are in rural and regional areas. The geographic spread of schools and relatively small number of students in some schools can make the economic efficiency of these enrichment programs a challenge.

Our sponsors had committed financial support to the STEM Schools Partnership (SSP). It commenced in 2013 with support from QGC, APLNG/Origin, Santos and Arrow Energy. The SSP was facilitated by the Queensland Department of Education, Training and Employment.

The SSP is particularly focused on schools based in rural and regional Queensland in the Darling Downs South West (DDSW) region. The choice reflects the sponsoring bodies' project footprints. It recognizes the existing gap between rural and urban schools in terms of the available range of STEM subject offerings and subsequent student destinations in STEM areas.

We were requested to evaluate activities offered through the SSP program to assure that each program was being delivered as effectively as it could be with the resources available and to ensure that the right suite of programs was on offer. At the time of writing, no suitable, widely-accepted, evaluation frameworks to evaluate such STEM enrichment programs were evident. This report therefore provides a detailed and evidence-based framework for evaluation of STEM enrichment programs for schools.

Study Methodology

The evaluation framework is underpinned by findings of a multi-stage investigation. The research team revisited fundamentals of program evaluation identified in the literature, undertook consultation with experts in the field in relation to the specific challenges in evaluating STEM enrichment programs, and assessed the nature of benchmark STEM programs internationally. Additionally, the team interviewed representatives of the SSP sponsoring companies and staff from Queensland DETE.

In addition, our team interviewed a sample of school principals, teachers, and students' parents in the Darling Downs Southwest Region – the target region for the SSP. This investigation confirmed the relevance of international literature on STEM enrichment programs in highlighting factors that contribute to program success, such as how best to engage students in early years of school in contrast to students in year 12.

Recommendations: Evaluation implementation plan

The research team has formulated a 'program logic' framework to structure the recommended evaluation elements.

Evaluating any one program's on students' career choices is likely to be challenging given that data about student destinations is available on only a limited basis for the first year post school. Our team therefore recommends a combination of evaluation methods in a strategy to triangulate data in support of findings. For example, we advise tracking participation in STEM subjects as students progress through the various stages of schooling, as well as a longitudinal study that tracks the outcomes for a small cohort engaged with the SSP over time.

At a detailed level, survey forms have been developed for use with students. An interview protocol has been derived to use with teachers, principals, and parents (see the report appendices) as part of this study. Recommended elements of the evaluation include assessments by program sponsors (*e.g.*, through occasional site visits) and by an external evaluator.

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1. Study Overview – Factors influencing an evaluation framework

1.1. The STEM enrichment programs at our focus - SSP Aims:

The STEM enrichment programs designed under the SSP aim to:

- Stimulate interest in studying STEM subjects at school through exposure to additional learning/education opportunities provided by the enrichment programs, and
- Increase awareness and knowledge of trade and professional career opportunities either in the sponsor's industry or with contractors that form part of the industry's supply chain.

1.2. The Investigation's Objectives

Objectives of our study include:

- Establish a shared understanding of future options / pathways for the STEM enrichment programs;
- Identify the current baseline measures of the take-up of STEM subjects and the decision to pursue a career in a STEM-related field among school students in the region;
- Conduct field visits in the region to test assumptions and methods needed to ascertain the impact of SSP programs delivered; and
- Establish a methodology through which the outcomes of the SSP can be evaluated in future years.

1.3. Scope of Work (SoW)

Consultation with stakeholders resulted in the SoW being defined by two core concerns:

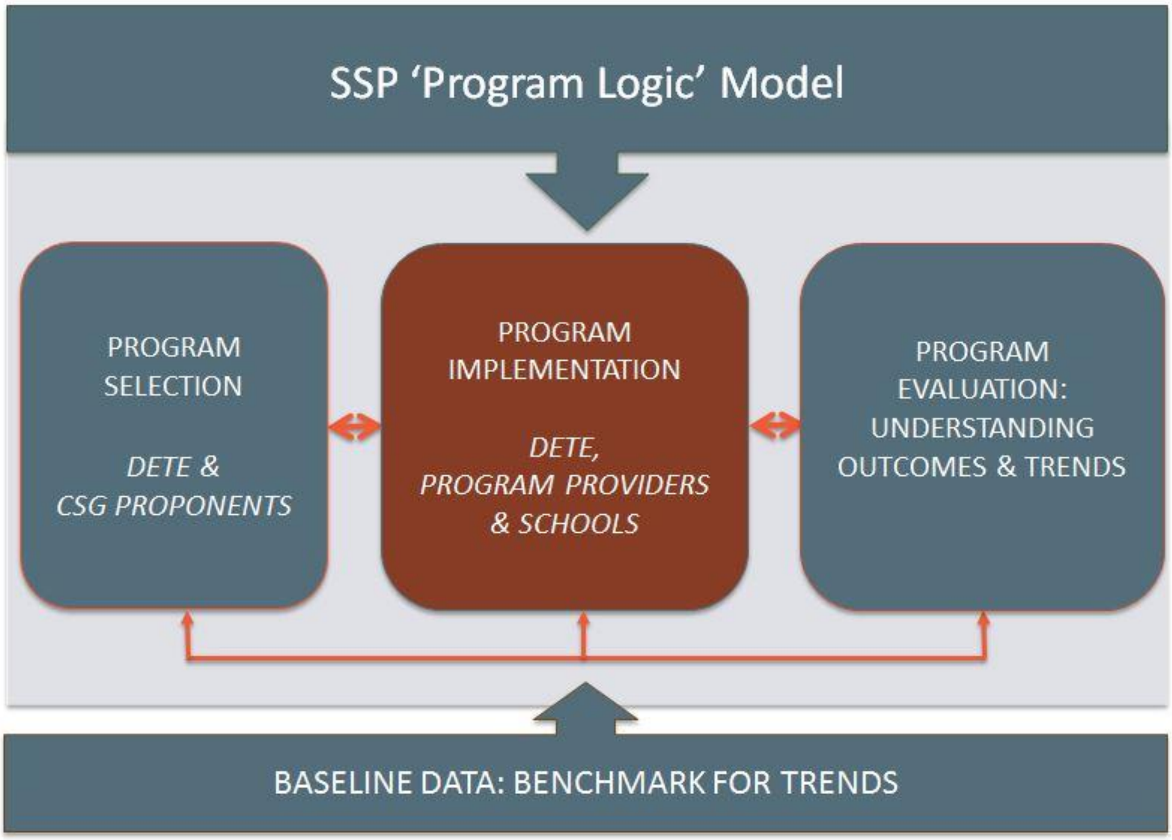
i. Investigating the potential of the 'program logic' model for the SSP program; and

ii. Understanding criteria that can be used to select STEM enrichment programs in the future.

The relationship is illustrated in Diagram 1.

1.4. Alignment of SPP components

Diagram 1: Alignment of SSP components



Specifically, the alignment of SSP components comprises:

- **SSP 'program logic' model**: the logic model serves as a framework for both planning and evaluating the STEM enrichment programs. It links the intended goals, objectives and strategies into a roadmap. Also, the program logic model distinguishes outputs, immediate effects (outcomes), and potential impacts that may result through the STEM enrichment activities. The model also assists actors, such as schools, the Queensland government's DETE office, the program's sponsoring companies, program providers and others (*e.g.*, communities and educational organisations) to recognise common goals in implementing the STEM enrichment programs.
- **Program Selection**: a list of international 'good practices' that tend to contribute to the success of STEM enrichment programs are provided to assist selection of the right programs, those that can contribute to the achievement of goals as stated in the program logic model. These criteria have been generated from an intensive literature review as well as input from the school interviews.
- **Program implementation**: all components developed through this study are expected to inform the implementation of STEM enrichment programs.
- **Program evaluation**: Recommended elements of the evaluation framework for the STEM enrichment programs are discussed in this report. Although our main task is to develop an outcome-based evaluation, the suggested evaluation elements also suggest and clarify self-assessment or internal, formative evaluations to be conducted by the program providers.

- **Baseline data**: the baseline data provided in this report serve as initial quantitative and qualitative benchmarks. The acquisition of the quantitative data for this report was mainly from the Queensland government's DETE statistical data centre. The qualitative data highlights the nature of impacts that principals, teachers, and parents hope to see and suggest initial outputs (participation numbers) and outcomes (interest) for students.

1.5. The Research Methodology

The study methodology comprised five core stages with potential for a sixth stage – implementation of the evaluation program - to be negotiated at a future date (described in Table 1). A summary of activities undertaken for each stage is outlined below.

Table 1: Research stages, activities, timelines and milestone/output

Research Stage	Activities	Milestone and Output
Stage 1: Scoping	• Start-up meeting • Obtain UQ ethical clearance • Obtain DETE research approval • A consultative meeting	• A summary of meeting results with industry sponsors • Developed criteria for school selection
August to September 2014		
Stage 2: Literature review	• Success benchmarks for STEM enrichment programs • Factors influencing kids learning science • Program logic model for STEM programs	• Bibliography for the study • Draft SSP program logic model and parameters to select STEM programs
September – October 2014		
Stage 3: Establishing baseline and evaluation framework	• Acquire data from DETE • Analyse data and specify key indicators • Develop questionnaires and survey instruments	• Draft Questionnaires and survey instruments • Engaged with 4 schools and interviewed 12 school participants • Gain an understanding of how local experiences correspond with prevailing views in literature.
Stage 4: School engagement	• Select schools and engage with DETE for an introduction to engage with schools • Contact schools to participate in the study • Schedule interviews with school participants • Visit schools and conduct interviews	
October – November 2014		
Stage 5: Refining the evaluation framework and reporting	• Analyse interview results • Collect supplementary data • Refine and design evaluation framework • Prepare draft report • Submission of draft report • Review with program sponsors	• Presentation to program sponsors for the research findings and evaluation framework • Final report submission

November – January 2015	
Stage 6: Implementation	Materials and timelines to be discussed separately from this report

1.6. Ethical considerations

This study has been conducted in accordance with the ethical guidelines of the Behavioural and Social Sciences Ethical Review Committee at the University of Queensland.

These guidelines stipulate that all participants be informed that their contribution to the study is voluntary and confidential. All data has been aggregated, and any quotes or other interview material reported for this study have been de-identified to protect individual confidentiality.

It is a requirement of the University of Queensland that participants be provided with feedback on the outcomes of a research project.

This study has also received a letter of approval from the Regional Director of the Queensland DETE for the region, which allowed CSRM researchers to invite schools within this region to participate in the study. Subsequently, this study has adhered to DETE's Standard Term and Conditions of Approval to Conduct Research in Departmental sites. These requirements also include provision of a report for study participants.

1.7. Context: Programs in operation 2013-14

Several STEM enrichment programs have been conducted in the period of 2013-14, as listed in Table 1. Currently, the SSP is preparing for further implementation in 2015. These programs are listed to suggest the range in types of programs to which this evaluation framework can be applied.

Table 1: SSP STEM Enrichment Programs 2013/2014

Program	Description
ATSE Wonder of Science	Developed by the Australian Academy of Technological Sciences and Engineering Target: Year 6 – 9 in 41 schools
Skills Tech Professional Development	Two courses have been conducted at Skills Tech Australia's, Acacia Ridge campus in Brisbane: • Careers and vocational training requirements • Skills builder for industrial technology teachers Target: guidance officers and heads of department
Apollo Archimedes	Supported Dalby SHS to write the school's existing Apollo Archimedes project into a complete, commercial quality, curriculum resource. Target: the program is designed for Year 6 – 9.
Formula 1 School	Supported schools to compete in the FI program (run by QMI Solutions) and developed an F1 curriculum Target: Cluster of schools to have F1 school hubs set up
Power of Engineering	An engineering awareness program including keynote speakers, workshops, and tours to engineering sites Target: Year 9 – 10
Try a Trade	A 10 week pre-vocational 'try trade' training program and a week-long camp Target: Year 10

1.8. Report Structure

Chapter 1 - **Study Overview** provides the background of the study including the SSP and a description of study methodology, scope of work, ethical considerations, and evaluation recommendations.

Chapter 2 - **Current Baseline: Quantitative trends** - discusses current trends among students studying STEM subjects and what proportion pursue further STEM studies after completing Year 12. These data are provided to characterise the context for which this evaluation framework was developed.

Chapter 3 - **Current Baseline: Respondent perspectives** - provides the perspectives and opinions of the small number of people interviewed about the SSP and its current programs during the October 2014 visit in selected schools.

Chapter 4 - **Suggested key criteria for STEM enrichment program design** - triangulates findings from the literature review on key criteria that can lead to positive outcomes from STEM educational programs with interview results. Nine key criteria are discussed in this chapter.

Chapter 5 - **Evaluation Framework** - provides the SSP program logic matrix, a presentation of the SSP's intended outcomes, and details on evaluation methods and data gathering.

2. Current Baseline: quantitative trends

2.1 Definition of STEM

The term STEM aggregates four broad disciplines: Science, Technology, Engineering and Mathematics. Each of these disciplines consists of several sub-disciplines. In this report, the classifications of STEM are consistent with the Queensland government's DETE classification, which comprises the following:

- The STEM subjects that students can take in their school life as classified in One School Corporate Reporting (OSCR) (Appendix 1)
- The Australian Standard Classification of Education separates fields of study in higher education into four categories: natural and physical sciences; information technology; engineering and related technology; and agriculture, environmental and related studies (Appendix 2 and Appendix 3)
- Occupation categories are classified based on the Australian Bureau of Statistics' Australian Standard Classification of Education (2008 – 2012) and the Australian Bureau of Statistics' Australian and New Zealand Standard Classification of Occupations.

Definitions of subject areas that count as STEM are likely to vary from state to state, province to province, and country to country.

2.2 Students studying STEM subjects

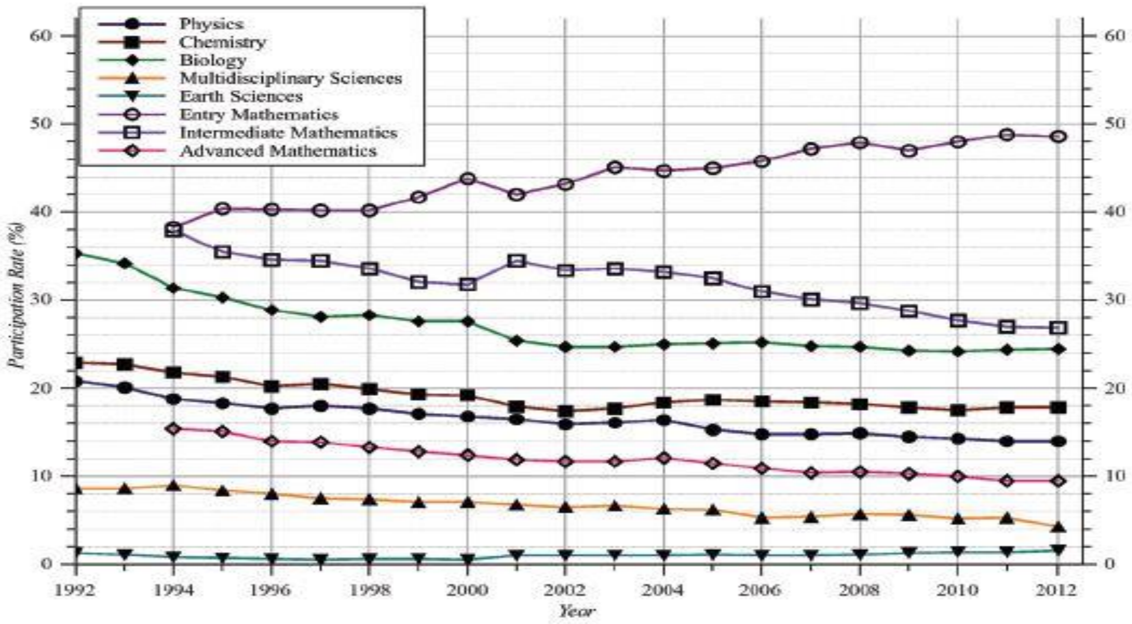
The recent reports suggest that interest in science and mathematics in schools and universities in Australia has declined (Office of Chief Scientist, 2013). This reduction has resulted in a sense of urgency in stimulating the interest of children in learning STEM subjects.

DETE DDSW region provided data for the percentage of students choosing STEM courses based on census dates of 5 August 2012 to 2 August 2013 for One School Corporate Reporting (OSCR). The given data covers students from Year 10, Year 11 and Year 12.

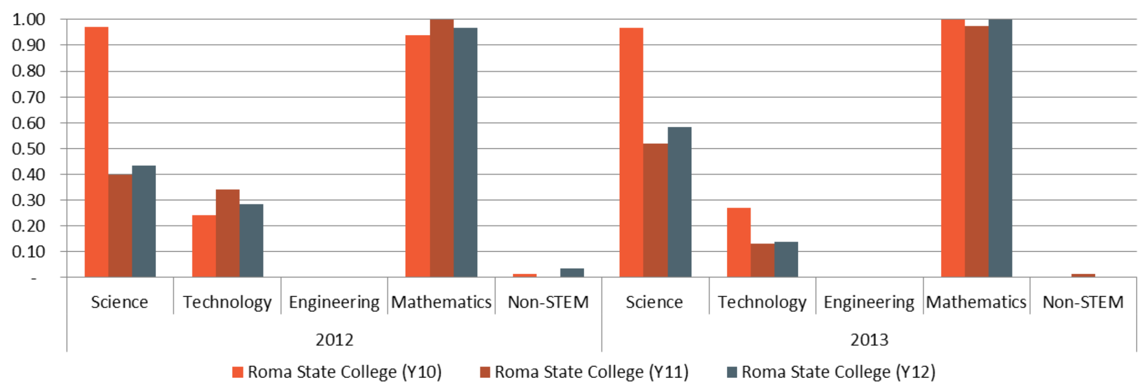
Time series data for students studying STEM subjects in the DDSW were not available at the time that this report was prepared, but national trends and Queensland trends are evident. So, for the region, CSRM researchers have been unable to analyse and provide the long-term trends on the numbers of Year 10, Year 11 and Year 12 students studying STEM subjects. However, nationally, Kennedy et al (2014) suggests that students' enrolments (implied by participation rates) in science and mathematics subjects have been declining, except for the Earth Sciences, which exhibits marginal growth, and entry-level mathematics, which shows steady growth (Graph 1).

To understand these trends in DDSW region, Graphs 2 to 4 provide participation rates (fraction of students) in STEM subjects for Year 10, Year 11, and Year 12. These graphs are consistent with the national trends provided by Kennedy et al (2014). The quantitative results show that enrolment varies significantly between year groups, and it varies from year to year. To confirm these trends locally, CSRM researchers interviewed teacher and principals in these represented schools, and their opinions are presented below.

Graph 1: National participation rates for Science and Maths (Kennedy et al 2014)



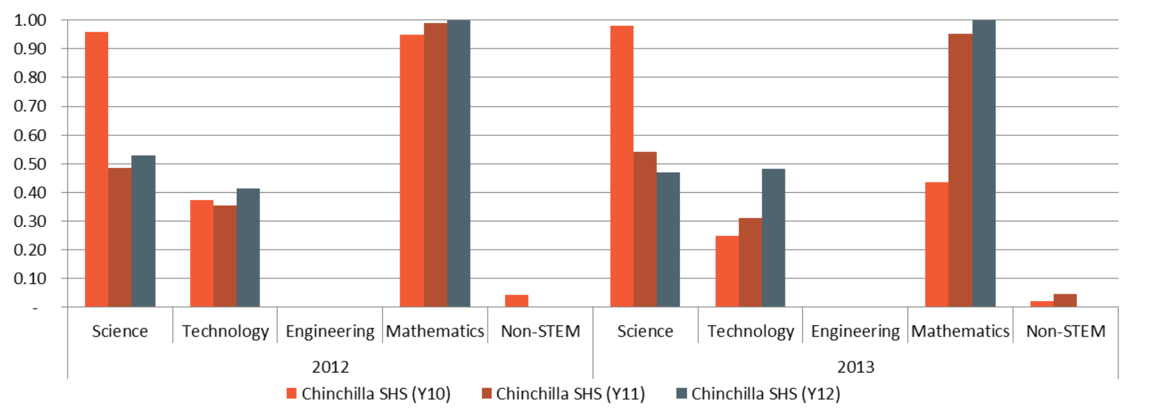
Graph 2: Y10 – Y12 participation rates for STEM subjects at a sample School (%)



Interview results (2014):

- A plateau for students taking science subjects
- Biology (Y11&12) = 20-25 students
- Physics (Y11&12) = 8 students
- Apprenticeship/traineeship: 40 – 50 students
- Trend in past 5 years: a third (university) & two-thirds (vocational pathways)

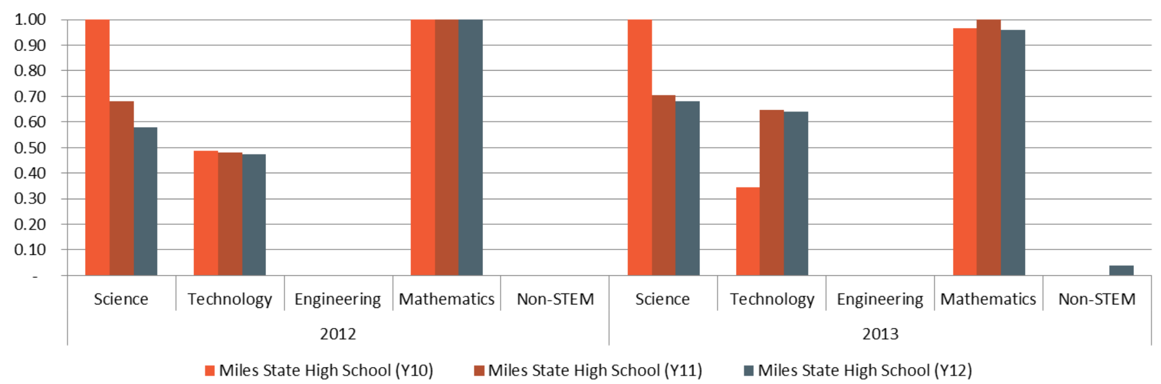
Graph 3: Y10 – Y12 Participation rates for STEM subjects at second sample School (%)



Interview results (2014):

- Not included in the October field visit

Graph 4: Y10 – 12 Participation rates for TEM subjects at a third sample School (%)



Interview results (2014):

- Biology remains a strong class:
  Y11 (11 of 26 students; Y12 (12 of 35 students)
- Physics: a long-distance class:
  Y11 (4 students); Y12 (2 students)
- Trend in past 5 years:
  more students considering university & fewer for trades

2.3 Student Destinations

The data provided here are based on the DETE DDSW region data extracted from the Next Step Survey. Next Step is an annual survey of young people who completed Year 12 in the previous year. The survey provides information about student destinations six months after leaving school in terms of status of employment and further study. The Next Step Survey aims to track all students who completed Year 12 in Queensland in the previous year and received a senior statement from the Queensland Curriculum and Assessment Authority (a record of completion). It is a voluntary survey, and as a result data, it may not be conclusive in that the response rate is not 100-percent.

2.3.1 Year 12 completers choosing to take a STEM apprenticeship or traineeship program

This section provides information about the trend of STEM occupations of Year 12 completers from DDSW region who were undertaking an apprenticeship or traineeship from 2008 – 2014. The overall trend for students taking apprenticeship and traineeship programs once they graduate from Year 12 has been generally declining.

Results from individual schools show fluctuations from year to year in the numbers of students taking STEM and non-STEM apprenticeship and traineeship programs. One school showed a counter-trend, with the uptake of STEM based apprenticeship and training opportunities increasing.

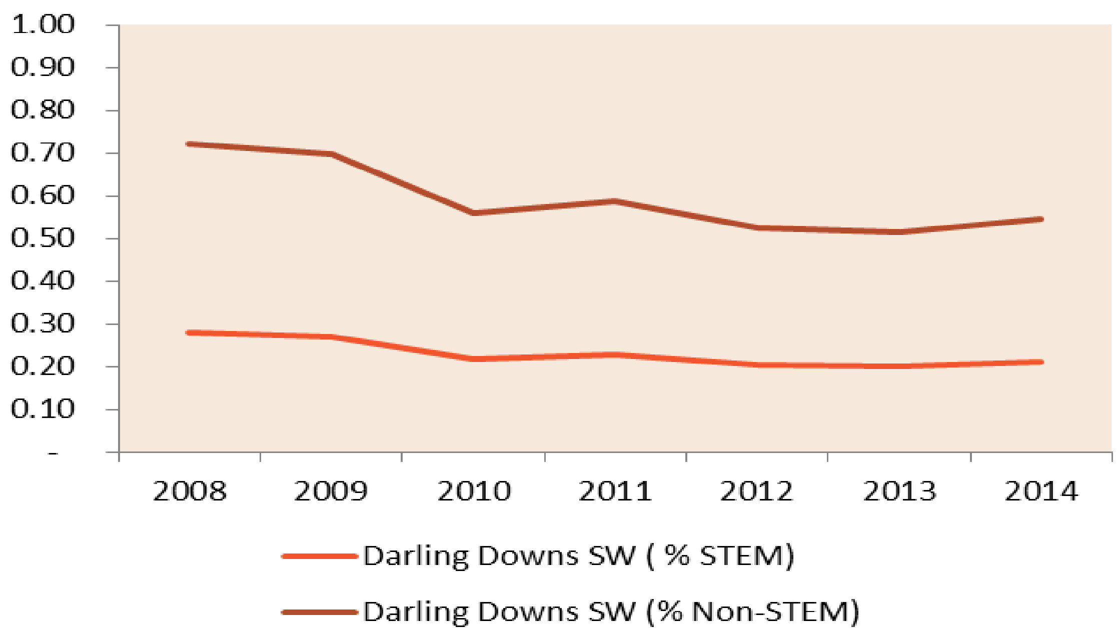
2.3.2 Year 12 completers choose to study a STEM field at University

The trend of Year 12 graduates in the DDSW region selecting STEM fields of study at university from 2008 until 2014 is provided in Graph 7. It is clear that the number of Year 12 graduates choosing STEM fields of study at university has been declining over time. Within this period, the average is approximately 95 students decided to study STEM fields compared to 277 students for the non-STEM fields of study (i.e., 1 every 4 students aims for STEM subjects, as shown in Table 3).

Table 2: Numbers of Year 12 completers choosing to study STEM programs at university from 2008 to 2014 in DDSW

Local Government	2008	2009	2010	2011	2012	2013	2014	Average
Darling Downs SW (STEM)	84	83	108	85	95	117	94	95
Darling Downs SW (Non-STEM)	217	228	280	286	318	305	305	277
Total	301	311	388	371	413	422	399	

Graph 5: Percentage of Year 12 completers choosing to study STEM programs at university from 2008 to 2014 in DDSW



In two of the three selected Local Government Areas (LGAs), STEM enrolments at university have been consistent in recent years, with an increasing number of Toowoomba students heading into STEM areas (Graph 6 and Table 3). Graph 9 provides the percentage of students studying STEM fields at university, indicating that the percentage of Toowoomba students going on to study STEM at university has declined. These data illustrate trends and variations across regions. Note that figures for smaller regions can fluctuate more than those for larger regions – an expected statistical effect.

Graph 6: Numbers of Year 12 completers choosing to study STEM programs at university from 2008 to 2014 in Toowoomba, Western Downs, and Maranoa LGAs

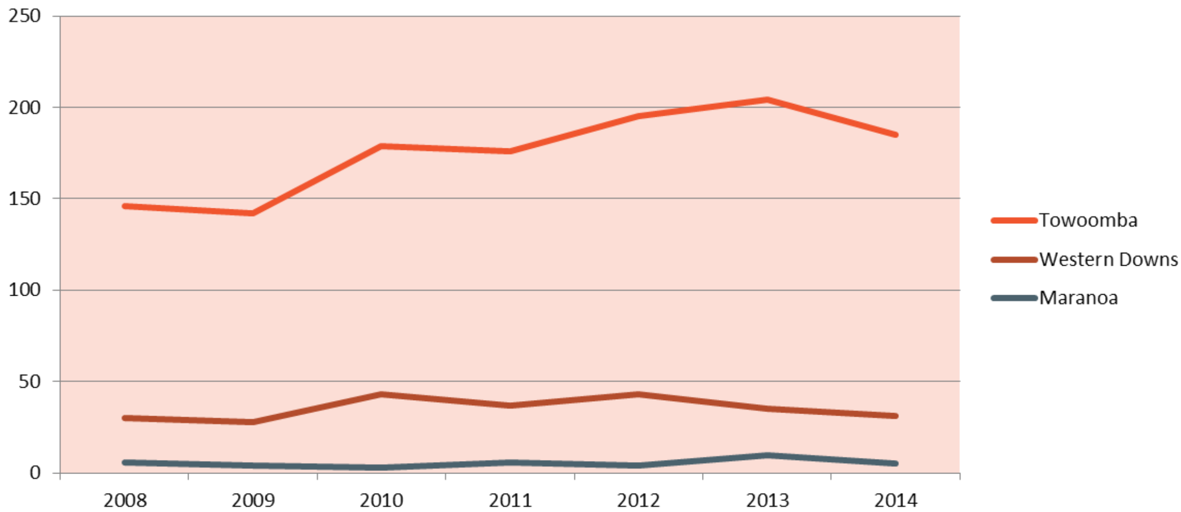
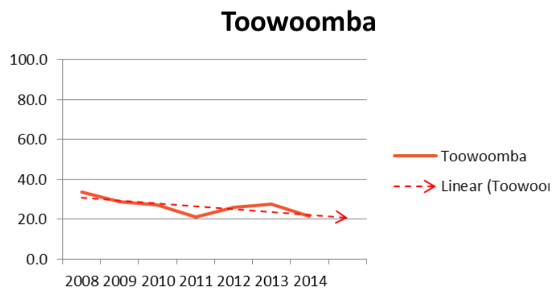
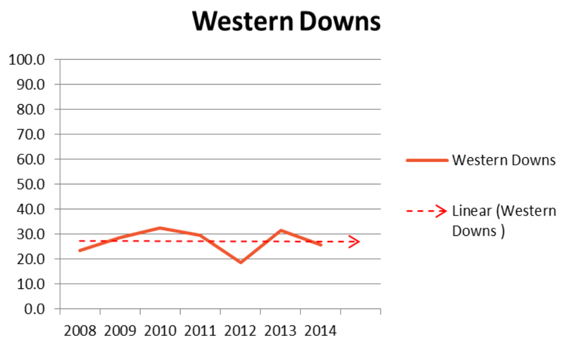


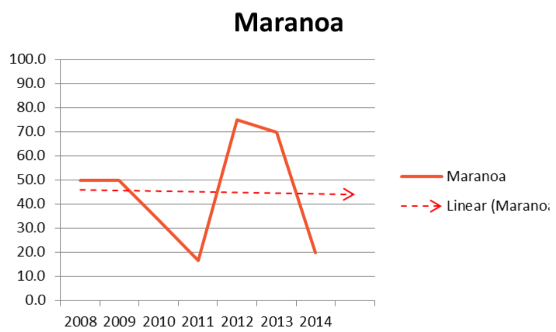
Table 3: Year 12 completers choosing to study STEM program at university from 2008 to 2014 in Toowoomba, Western Downs, and Maranoa LGAs

Local Government	2008	2009	2010	2011	2012	2013	2014
Toowoomba	146	142	179	176	195	204	185
Western Downs	30	28	43	37	43	35	31
Maranoa	6	4	3	6	4	10	5

Graph 7: Percentage of Year 12 completers choosing to study STEM programs at university from 2008 to 2014 in Toowoomba, Western Downs, and Maranoa LGAs







Local Government	2008	2009	2010	2011	2012	2013	2014
Toowoomba	33.6	28.9	27.4	21.0	26.2	27.5	21.6
Western Downs	23.3	28.6	32.6	29.7	18.6	31.4	25.8
Maranoa	50.0	50.0	33.3	16.7	75.0	70.0	20.0

Source: DETE Next Step Survey

3. Current Baseline: quantitative trends

3.1 Factors influencing students to select to study STEM

Three main factors influencing students' decisions on whether to study science and mathematics were suggested by the school teachers, principals, and parents interviewed during our school visits in October 2014.

3.1.1 Observing and supporting early interest toward science is important

The majority of respondents agreed with the literature that introducing science and mathematics at an early age is important. One parent mentioned that she found that her son developed a strong interest in science and engineering at an early age. She stated that her son is comfortable in studying science and mathematics and says that he could be an industrial or electrical engineer. This respondent observed that the Western Downs and its surrounding region can cater for future careers in engineering due to the importance of mining.

Similarly, a teacher agreed that it is important to inspire students with science and mathematics subjects from an early age. A teacher with more than 30 years of experience observed that he found that children lose interest in studying science when they are in Year 8 and Year 9. Interventions for the older children (above year 8) may not be successful as they may be too late. That corresponds with current thought regarding science enrichment in Australia - that early interest in science wanes in later years. Another teacher mentioned that although science is listed on the curriculum for the primary school, "*it's a bit hit-and-miss whether the students are even taught science*".

Another teacher shared ideas on activities that can be introduced to younger students, such as: little experiments to boost their enthusiasm and curiosity; and encouraging kids to think and to concentrate. It was suggested by the teachers interviewed that programs should be:

- designed to cater to various learning capabilities;
- convey to students the importance of doing science in upper years;
- expose to them to various STEM career paths.

A teacher concluded that introducing STEM enrichment programs at early years would be beneficial to 'embed' science in students' minds.

As suggested above, this notion of anchoring interest in STEM early in a child's life resonates with findings from international literature.

3.1.2 Role of teacher in encouraging students to like STEM subjects

Teachers have a significant role in influencing young people to learn science and mathematics, according to anecdote, studies, and our interviews. A parent mentioned that teachers have been 'very instrumental' to bringing the interest in STEM back for her daughter and her peers. However, she further stated that teachers can also discourage students from studying STEM subjects if the teaching styles are not engaging.

For rural schools, all school principals mentioned that it is difficult to find experienced and good quality teachers who are passionate about teaching science and mathematics.

Teachers noted difficulties in convincing students to study STEM subjects. Among barriers that teachers cited are: attitudes and dispositions of some children and their parents and limited time in class to go through the theoretical concepts of STEM. Teachers explained that there has been some stigmatization against students taking up harder mathematics subjects. This stigma is evident in comments such as an "I-don't-need-it attitude from students". Some students are reported to be saying that, "I am not good at mathematics" or "I was not good in primary school [so I can't be good with mathematics]".

To bridge this gap, one teacher introduced mathematics tutorials outside normal teaching hours. The tutorials have been running since mid-2013 to assist Year 12 students who are taking mathematics B and C. Other strategies that have been undertaken include: regular homework sheets; 12 quick mathematics questions once a week as a warm up; and the "IXL on-line mathematics program", which is used as an avenue for students to practice mathematics.

3.1.3 Role of parents and scientific literacy

Respondents agreed that parental assistance and home environment have a great influence on whether kids enjoy learning science and mathematics. In the Western Downs and Maranoa regions, school respondents mentioned that the socio-economic background of households varies, with a significant gap between the rich and the poor. The relatively higher wages earned by parents in the resource development sector – mining and natural gas – is reported to have made the gap wider (what has been referred to locally as a two-speed economy). Kids who have a parent working in the mining sector have a greater exposure to ideas around science and mathematics as well as the support at home needed to pursue this path. However, small towns in rural areas often cannot cater well to such aspirations, they noted.

A parent mentioned that it is important to not only provide rewards for kids who are excellent in sport but also to reward students who are doing well in their academic achievements. This parent felt that there has been an imbalance among the messages passed to rural kids – she stated that, "Dalby has been more of a sporting town, but we need to build and develop intelligent and smart leaders."

Some respondents mentioned that, in many cases, kids either do not know or are uncertain about their future paths (study fields at university or career ideas). Therefore, parents have a greater role in introducing opportunities to their kids so that they can make an informed career decision.

Parents also suggested that it is important for parents and teachers to increase communication about teaching programs and performance of students. Parents need to be informed, "where their kid is expected to be in their learning". Teachers concluded that it is very helpful and influential on the kids if the parents value homework from school and help their kids when studying at home from a young age.

These insights resonate with recent international studies indicating that 'science capital' plays a major role in influencing children to study STEM. Science capital includes having a parent or other influential adult working in a field related to STEM or showing a keen interest in STEM.

3.2 SSP Justifications and preliminary outcomes

3.2.1 The Partnership (SSP) is 'a great thing' for rural students

In general, the partnership between DETE and the SSP's sponsoring companies has been strongly valued by the school respondents. The majority of respondents provided positive feedback on how the companies support the STEM programs including:

- good for rural students who have limited exposure to science programs
- retain top end students to keep studying in rural schools

- the program provides opportunities to students with an interest in maths and science, which is typically not very evident in rural schools
- opens new horizons for kids about STEM career paths.

A respondent mentioned that despite some controversy in the region about the sponsor's industry in relation to the agriculture sector, the partnership is "a great thing" because "it provides access to STEM programs that rural kids did not have previously".

All principals mentioned that their schools rely on public-private partnerships and support from the community. A principal stated, "That's what this school runs on." All respondents suggested that the partnership – industry sponsorship - continues with further strengthening and two-way active communication, leading to meaningful, purposeful and valued programs. Respondents agreed that if the partnership is done properly, it will maximise opportunities for schools, and it is expected that the outcomes will be sustained and show tangible results in the future.

3.2.2 Broaden young people thoughts and minds

All parents stated that they will definitely encourage their children to keep participating in the STEM enrichment programs when they are available in the future. These types of programs are good as they broaden the minds of young people, some noted.

3.2.3 The fun of a day out

Teachers explained that it is important to make the STEM enrichment programs as fun as possible. Kids love learning and playing at the same time, they noted. Learning STEM subjects outside schools has been limited for rural schools. Subsequently, the STEM enrichment programs have filled these gaps for young people to have a fun learning day outside the classroom.

3.2.4 Positive observed impacts on learning

Box 1: Feedback for two of the programs

- Young scientists were fantastic with the kids. They really captured the kids and have taken it on board.
- It encourages students to believe in themselves, as "sky is the limit!"
- Totally enthralled the kids
- My son enjoyed the program
- The program got my son thinking and encouraged him to do different things in the shed, even more enthusiasm
- The program invigorated the students
- Students were excited about the program
- The program is a good stepping stone for the students

(*Feedback from respondents*)

The majority of respondents agreed that the STEM enrichment programs have enhanced the learning environment in schools.

Interviews enabled researchers to collect feedback on the variety of ways in which individual programs had impacted them. For example, positive feedback on observed impacts of two of the programs is provided in Box 1.

A parent from one school offered interesting feedback regarding another program. She mentioned that the program has helped her son, an average student (grades B and C) to improve his academic performance (now getting grades of A). Her son has shown confidence studying engineering and science, and he has decided to study engineering and science for his senior subjects and higher degree education.

Similarly, trade-oriented program has been seen as useful to assist students to make an informed career decision.

3.3 Identified Gaps and strategies for improvements

Interview respondents highlighted some gaps in the implementation of the STEM enrichment programs. The major issues or concerns raised are described below. These concerns about SSP offerings might arise in any sort of program.

3.3.1 Planning

Early planning for the STEM enrichment programs

Teachers and principals noted that they have been inundated with offers for school programs. To better implement such programs, they urged early planning between schools and DETE (including service providers) for the STEM enrichment programs. Early planning can benefit in several ways, such as facilitating synergies among programs.

A principal stated that the school needs to know the content of a particular program beforehand so that teachers are not "*double-teaching*". He further explained that students were happy to be engaged but had trouble aligning the enrichment activities with what the teachers had already planned to do. For this reason, school principals mentioned that their schools need to be selective about which programs they choose to receive. They will seek programs that have a good structure and a compatible focus.

Improve link between programs and school curriculum and teaching schedule

Teachers and principals suggested that programs need to link with the school curriculum. Teachers felt that two of the SSP programs had limited alignment with their school curriculum. To overcome this gap, STEM program providers need to engage with schools to link the content of STEM programs with the school curriculum. Importantly, the implementation needs to link with the teaching schedule or "*what's happening in the class to avoid double teaching*" (as noted above), in particular for primary school students.

Solid long-term plan for the partnership to have meaningful programs

Overall, the STEM enrichment programs in the SSP have shown initial impacts as "*the programs seem to be changing the perception of science on students*". For future planning, a respondent mentioned that, "*the partnership needs to ensure that the STEM enrichment programs are right, targeted, relevant, purposeful and add value for money.*"

Suggestions arising from the interviews are that, for the long-term, programs need to be: embedded and established for students in each school; consolidated with the curriculum and teaching schedules; and eventually be maintained or sustained by schools. For the effectiveness of the programs, there should be "*buy-in*" from schools with strong commitment.

3.3.2 Program Design

Special attention needed for chemistry and physics subjects

A teacher suggested that the STEM enrichment programs need to focus on chemistry and physics subjects. Students seem to show weak performance in these subjects. Through 20 years of personal observation being a teacher, this respondent found that, "*kids cannot always see value or link in doing physics and chemistry.*" In recent years, the teacher reported that there has been a 50-percent drop in the number of students studying chemistry and physics. The teacher explained this trend as due to the following, "*students perceive physics and chemistry as being more difficult. Memorising is required for chemistry (for example, the periodic table and the element symbols) as well as a little bit the same for physics.*" The technological age of the internet might impact on students when "googling" has become a habit rather than remembering or recalling, the parent noted. Therefore, he thought it is important to find ways to make chemistry and physics fun (and presumably memorable) subjects.

Another reason that perhaps contributes to the declining trend of students studying physics and chemistry is teacher capability. A senior teacher mentioned that there is a lack among rural schools of teachers with university education in the science disciplines (specifically in chemistry and physics). Teachers who have a background in chemistry and physics, despite limited teaching experience, must be confident in teaching these subjects, and they may be better at providing students with new approaches to learning these subjects, the teacher noted.

Engineering subjects are limited in many schools

Engineering subjects are limited at many schools. School representatives have greatly valued the engineering aspects of the STEM enrichment programs tailored to each school. Apollo Archimedes and F1 have inspired and encouraged school staff to teach engineering subjects to students. The school principals noted that they are optimistic that these programs can encourage students to enjoy learning engineering subjects.

With limited subjects on offer for engineering, a teacher mentioned that, "*not as many students are going into science and engineering … A lot of young people think it's too hard, and it puts them off.*" He noted that it is important to pass on the message that, "*you don't have to be brilliant or a genius … you just have to be interested in science.*"

Engagement with industry-related material

A variety of feedback was received concerning the design of the STEM enrichment programs and whether they should cover more industry-related topics (that is, topics related to the sponsor's industry). Within some schools, teachers expressed different understandings of the STEM enrichment programs. Some mentioned that the current programs need to broaden the content and 'messages' rather than just focusing on matters related to the sponsor's industry. Other respondents mentioned that STEM enrichment programs have been lacking in encouragement for students to understand more about the industry operating in the region.

Some suggested activities to link students and the industry include:

- Allow Year 10 students to have work experience in the sponsoring companies (technical or administration placements);
- School-based traineeships for Year 11 and Year 12;
- Post-school career pathways program;
- Bus trips for students to visit the industry's facilities and infrastructure;
- Water program would be very beneficial (as water is a big part of the industry).

Other industry engagement avenues

Other suggested programs that may inspire students to consider STEM-related careers include:

- **Guest speakers seem effective and more are needed -** Schools have requested more guest speakers from the industry to present to students. When students spend time with engineers, designers and other staff, they become inspired and gain a better understanding and impression of those career options.
- **Visit to industry sites -** These activities have been regarded as effective by high school teachers in inspiring students studying STEM subjects in a way that can lead to STEM-related careers. A school principal mentioned that, for effective learning, it is important for students to experience things rather than just talk about them.

3.3.3 Target groups

Specific programs for girls

As discussed in the literature, there has been a smaller proportion of girls (than boys) studying science-related subjects (particularly physics, chemistry and engineering). Information provided during school visits made apparent that girls who do study science tend toward biology subjects but represent small numbers in other subjects.

Overall, teachers suggested that it is important to provide specific STEM enrichment programs for girls so that they can be inspired to pursue further study and/or a career in these areas. The SSP seemed to have a program for girls, though a program on women who weld was prior to the SSP. For this program, a principal noted that the intention was good, however, the implementation was questionable. This respondent suggested that *"the quality of the facilitator is important, and they must be skilled*".

Involvement of teachers in the programs

As described in Section 3.1.2, teachers have a significant role in motivating and inspiring students to study science and mathematics. Yet almost all respondents mentioned that there have been limited programs for rural teachers to improve their professional development in STEM fields.

A parent mentioned that, "*excellent teachers will teach beyond what is expected, and this is really inspiring for students.*" This tendency is evident in their children's school, where the physics teacher has been very engaging and interactive with the students. This teacher tries her best to think 'outside the square' in delivering physics education to students.

A principal suggested that it would be effective if the SSP effort can provide supporting programs for teachers, especially, "*to have someone come in with particular skills that the teachers do not have.*" This respondent suggested that perhaps improving the capacity of teachers in a "*Curriculum to Classroom or C-to-C unit*" is a good program. Another program is an expert model, to bring someone with a higher degree expertise in science to mentor teachers in delivering STEM subjects - in particular for upper grades. Also, a principal suggested that it is important to link teachers with the sponsoring industry as teachers can share their experiences and "*can bring the real world into the classroom.*"

Indigenous and marginalised students (*e.g.*, low socioeconomic status and students seen as less traditionally academic)

Students in rural schools have limited access to educational programs and fewer opportunities to participate in out-of-school STEM programs. Respondents mentioned that Australian rural towns do not provide incentives for young people to learn science, and there are limited services and public places (*e.g*. museums or science centres) for kids to learn and explore science in comparison to students in the city. In light of these limitations, STEM enrichment programs are viewed as beneficial in supporting young people to learn and explore science and mathematics.

Current SSP programs have been were noted to cater for students who are comfortable in the mainstream classroom and can perform "*excellent*" in science and mathematics. Respondents noted that the STEM enrichment programs also need to support economically marginalized students and provide opportunities for students who are not so "*brainy*" but have interests in studying science and mathematics. There are similar implications for ensuring that the needs of Indigenous students are captured in program design.

3.3.4 Caveats & implications

It is important to note that those interviewed by the research team could be seen as self-selected. School principals could have seen it as important to represent their school's interests and be eager for supplemental programs to continue, and similarly for teachers. The parents who provided time for the interview would likely have gone out of their way due to a keen interest in STEM.

As a result, their positive comments should be seen as representative of those who are favourably disposed toward having the young learn more about STEM. Their constructive comments can be contextualised as coming from those who are interested in this domain, appreciative of the programs, and can see room for improvement. More important for this study than their specific suggestions, though, is to recognise the importance of including such input in a long-term evaluation framework.

4. Suggested key criteria for STEM enrichment program design

This chapter triangulates findings from the literature review (Appendix 4) on key selected criteria that can lead to positive outcomes of STEM educational programs, linking them to results from the October 2014 interviews (Chapter 3).

We suggest nine key criteria to be met when a sponsor or school selects STEM enrichment programs (Table 4). The criteria are undergirded by the assumption that each program contributes to a suite of 'treatments' meant to work incrementally as students' progress through three age groups. That is, programs in the lower years should be complemented by more sophisticated programs in higher years that can build on them.

Group One: Years 5 & 6 – A report from King's College London (2013) suggests that it is important to introduce science to children at an early age. For young students (Years 5 and 6), programs should focus on stimulating their interest to learn science and mathematics. Program providers need to design the programs to be enjoyable. That may include allowing students to play while learning at the same time. It is important that the content of the programs links with school curriculum and teaching class schedule. This alignment will allow students to effectively connect concepts and ideas from class with their out-of-class learning.

Group Two: Years 7 to 10 – Respondents suggest that engaging students in learning STEM during school years 7 to 10 is critical. Within these years of study, kids may lose interest in science or mathematics. Also, students in Year 10 need to make decisions about their career paths and whether they want to take senior STEM subjects as part of their university preparation. As a result, STEM enrichment programs for this group need to build student confidence and self-belief in their ability to master STEM subjects. Programs also need to assist students to 'make connections' between practical learning activities and daily life as well as between learning STEM subjects and career opportunities that may arise.

Group Three: Years 11 & 12 – At this level, most students have developed better perspectives as to what they want to study for their future careers. Consequently, programs should aim to 'challenge and prepare' them to be better equipped for higher education and training. Similarly, STEM enrichment programs need to assist them via interactive enquiry and problem solving. Other criteria, such as building self-belief, providing enjoyable programs, and curriculum alignment need to be considered. It can be argued that programs at this level may not be aimed at all students but only at those with some interest in STEM.

Apart from aiding a sponsor or school to select well-conceived STEM enrichment programs, these criteria form the foundation of a roadmap for a suite of such programs. The criteria align with the SSP program logic model as well as with the 'outcome hierarchy' that will be discussed in Chapter 5, which provides details of the evaluation framework developed for the SSP.

Table 4: Key criteria suggested in the literature that would lead to successful out-comes of STEM educational programs

Key Criteria	Year 5 - 6	Year 7 - 10	Year 11 - 12
Criteria 1: Activity's overall aim is to 'stimulate interest'	✓		
Criteria 2: Activities are enjoyable	✓	✓	✓
Criteria 3: Program is tied to school curriculum and timed to its schedule	✓	✓	✓
Criteria 4: Program includes informal learning and extra-curricular activities		✓	✓
Criteria 5: Program supports students' confidence and self-belief in doing well in STEM subjects		✓	✓
Criteria 6: Activities are aimed to help students 'make connections'		✓	
Criteria 7: Program features practical learning activities linked to daily life & local context		✓	
Criteria 8: Activities aim to challenge and prepare students for higher education and training			✓
Criteria 9: Activities challenge students through interactive enquiry & problem solving			✓

5. Evaluation Framework

To plan the evaluation framework, CSRM researchers engaged with staff program sponsors. This engagement was to understand the drivers for establishment of the SSP; to develop the program logic model, including the articulation of outcomes; to determine evaluation design and methods; and to develop plans for data collection and items to measure. These aspects are described in this chapter.

One can argue that this sort of framework would be useful for an evaluation process for any STEM enrichment program or for a suite of such programs.

5.1 Understanding the drivers for STEM enrichment programs

CSRM researchers met with program sponsors individually in August 2014 to discuss the motivations for establishing the SSP. From the meetings, it was apparent there are four main reasons for the industry sponsors to support the SSP, namely:

- influence students to undertake a STEM path
- increase awareness and knowledge of STEM career opportunities
- improve sponsor's social reputation, community engagement
- meet an obligation to contribute to long-term employment and education.

Another finding through the early engagement with the industry sponsors and DETE DDSW region is that the SSP currently does not have a strategic document that highlights the its intended goals, including the articulation of outputs and outcomes. Subsequently, to allow CSRM researchers to develop an outcomes-based evaluation framework, it is important to reflect aspirations and intended outcomes in an accurate program logic model.

5.2 SSP Program Logic Model and Outcomes articulation

The first step in the evaluation process involves understanding the SSP – gaining a clear picture how, why, and under what conditions the SSP works. Developing a program logic model for the SSP and articulating important evaluation questions and intended outcomes represent initial, iterative steps. These steps inform one another and the direction of the evaluation overall.

To this end, CSRM researchers have drafted the SSP program logic model - as provided in Table 5 - to outline how the SSP works toward reaching its intended objectives and outcomes. The diagram for this logic model employs the Minnesota State Model[1] with the contents altered to reflect key stakeholder input. This stakeholder input was gathered in meetings and field interviews conducted in October 2014. The input has been triangulated via comparison with results from the review of international literature on STEM programs and on education program evaluation.

The SSP program logic model highlights several elements:

- **Objectives and goals**: the statements of objectives are provided in relation to each target group (*e.g.*, Years 5-6; Years 7–10; and Years 11-12)
- **Inputs**: resources, opportunities, and activities that contribute to the STEM continuum

[1] http://www.mncompass.org/education/stem/assets/minnesota-stem-cradle-to-career-logic-model-and-key-measures.pdf

- **Outputs**: anticipated results from opportunities and activities (*e.g.*, number of participants)
- **Outcomes:** intended changes or benefits (*e.g.*, rise in STEM enrolments).

By understanding and identifying these elements, key parties involved in the SSP STEM enrichment programs can have a common understanding of outcomes that need to be achieved. Also, the development of the program logic model can assist the SSP program team to identify essential inputs to and linkages among the STEM enrichment programs – as well as to clarify the underlying assumptions about how and why the program works.

Elements of the SSP program logic model (as provided in Table 5) can, and should, be revisited at all stages of the evaluation and program selection and delivery. At a minimum, an evaluator and the SSP program team should revisit these components at key points in the program timeline in an effort to confirm anticipated results (that is, are these results still desired?) or to identify the need for a change in direction. It is also important to engage key stakeholders in this process (*e.g.*, school principals, teachers, program providers, and others as relevant) to design STEM enrichment programs. An evaluator can lead these tasks and consult with stakeholders as appropriate.

As it currently stands, CSRM researchers suggest that the SSP program team focus its efforts to achieve three main objectives (see Table 5):

- **Stimulate interest (Years 5 – 6): "***Interest in STEM can be stimulated through STEM enrichment programs that assist students to understand and apply science and mathematics skills to everyday life*"
- **Make connections (Years 7 – 10): "***STEM enrichment programs help students to build 'make connections' between class - rooms learning and solving real world problems*"
- **Challenge and Prepare (Years 11 – 12): "***STEM enrichment programs will support students learning in a rigorous core math program to prepare and challenge them to pursue university or vocational pathways*".

By contributing to the achievement of these objectives, the SSP's long-term goals are to fill STEM-based jobs and to ensure that STEM skills are used to solve real problems and develop innovative solutions. The other goal of the SSP is to build 'science capital' in the region and other nearby regions so that students gain ongoing support outside school for their interest in STEM areas.

Table 5: SSP STEM enrichment program logic matrix

Objectives and goals	**Stimulate interest** Interest in STEM can be stimulated through STEM enrichment programs that assist students to understand and apply science and mathematics skills to everyday life.	**Make connections** STEM enrichment programs help students to build 'make connections' between class - rooms learning and solving real world problems	**Challenge and Prepare** STEM enrichment programs will support students learning in a rigorous core math program to prepare and challenge them to pursue university or vocational pathways	**Long-term Goals:** ○ *STEM job vacancies are filled and workforce needs are met* ○ *STEM skills are used to solve real problems and develop innovative solutions* ○ *Building science capital*
	Year 5 – 6	**Year 7,8, 9 and 10**	**Year 11 and 12**	**University, vocational training and career**
<-- Inputs Resources, opportunities, and activities that contribute to the STEM continuum	**Teachers** have deep content knowledge as well as skills in teaching STEM subjects. Schools have appropriate **resources** (tools and equipment to support teaching STEM). **Parents** are supportive of student interests and learning in STEM. **Community partnerships** developed among education, community organisations, businesses and other sectors to support learning. **STEM enrichment programs** are enjoyable allowing hands-on learning; and align with class-room teaching. **The providers** have good administration and organisational skills.	**Teachers** have deep content knowledge as well as skills in teaching STEM subjects that can aspire students to make their decisions in studying STEM. Schools have appropriate **resources** (tools and equipment to support teaching STEM). **Parents** are supportive of student interests and learning in STEM. **Community partnerships** among education, community organisation, businesses and other sectors to support learning (regular guest speaker comes to school talking about STEM career opportunities). **STEM enrichment programs** promote student confident and self-belief in studying STEM; feature practical learning activities linked to daily life; assist students to make connections between studying STEM and its career paths. **The providers** have good administration and organisational skills.	**Teachers** have deep content knowledge as well as skills in teaching STEM subjects. Schools have appropriate **resources** (tools and equipment to support teaching STEM). **Parents** supportive of student interests and learning in STEM. **Community partnerships** among education, community organisation, businesses and other sector to support learning. **STEM enrichment programs** align with class room teaching; challenge students with interactive enquiry and problem solving; provide access to career-exploration and internship opportunities; and promote provide linkage programs through on-the job training/ apprenticeships /cadetships. **The providers** have good administration and organisational skills.	High school graduates interested and able to pursue university degree in STEM. STEM career and vocational training programs aligned with employer needs. Availability of career-exploration and internship opportunities. STEM businesses with connections to university and workforce training programs. Demand in STEM fields. Informal STEM learning opportunities providing lifelong learning.
<-- Outputs Results from opportunities and activities	**Number of students** participated in STEM enrichment programs. **Number of programs** conducted for students, teachers and parents/carers that are aimed to stimulate their interests to STEM.	**Number of students** participated in STEM enrichment programs. **Number of students** trained for *basic STEM skills* important in daily life and a variety of fields. **Number of programs** conducted for students and teachers to apply learning to solving real-world problems related to STEM.	**Number of students** received rigorous core math and science programs. **Number of high achieving students** pursued advanced STEM coursework. **Number of tailored programs** conducted for students and teachers to challenge and prepare students to pursue university or vocational pathways.	Students pursue STEM university majors, vocational training and workforce training. Students persist in STEM education and training programs. Individuals engage in lifelong learning in STEM.
<-- Outcomes The changes or benefits	Students are **inspired and confident** in STEM. Students **aware about options in STEM careers.** High achieving students in STEM reflect all population groups.	Students are **interested and confident** in STEM. Students **understand connections** across STEM, and between STEM and other subjects. Students **consider STEM careers while making important STEM subject choices.** Students **have the STEM skills** necessary to succeed in workforce training programs. High achieving students in STEM reflect all population groups.	Students complete high school both **intending to pursue and able to achieve in STEM.** Students **understand the connections across STEM and between STEM and other subjects.** Students complete high school **ready for college and technical training.** Students are **aware of STEM career opportunities and pathways.** High achieving students in STEM reflect all population groups.	Students have the STEM skills necessary to succeed in university and workforce training programs. Students complete STEM degree and training programs. High achieving students obtain advanced degrees. Certificate/degree recipients in STEM reflect all population groups.
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5.3 Recommended evaluation elements

In this section, CSRM researchers suggest four evaluation elements that are complementary (but can be undertaken independently). These elements fit under two evaluation categories: formative evaluation (ongoing adjustment) and summative evaluation (ultimate achievement).

5.3.1 Formative evaluation

The formative evaluation of STEM enrichment programs should be conducted with relatively high frequency by parties involved directly with the SSP STEM enrichment programs. The insights gathered during a formative evaluation are meant to inform future iterations of the program rather than to report ultimate outcomes.

There are two evaluation elements suggested under this type of evaluation:

- **Program provider evaluation**: Each program provider involved in the SSP needs to conduct pre- and post- evaluation. To date, each program provider has done its pre- and post- evaluation program. This effort should be continued with results placed in the context of information provided in Table 6 and aligning with the SSP program logic matrix provided in Table 5.
- **SSP program sponsor evaluation**: It will be conducted by representatives of the program sponsors. It is suggested that they attend and observe a particular offering of one of the STEM enrichment programs, such as a classroom activity or conference where students present. Detailed information for this evaluation element is provided in Table 7.

Reports from these two evaluation activities need to be collected and compiled by staff of the DETE DDSW region. A recording system of outputs from the STEM enrichment programs needs to be developed. This system will capture several output indicators, as provided in the program logic matrix (Table 5). These indicators include:

Years 5 – 6	Years 7 - 10	Years 11 -12
Number of students participating in STEM enrichment programs **Number of programs** conducted for students, teachers, or parents/carers that are aimed to stimulate their interest in STEM	**Number of students** participating in STEM enrichment programs **Number of students** trained for *basic STEM skills* important in daily life and a variety of fields. **Number of programs** conducted for students and teachers to apply learning to solving real-world problems related to STEM	**Number of students** receiving rigorous core math and science programs **Number of high achieving students** pursuing advanced STEM coursework **Number of tailored programs** conducted for students and teachers to challenge and prepare students to pursue university or vocational pathways

Information and data gathered from these evaluation activities will provide information for the summative evaluation that is discussed in the next section.

Table 6: Program Provider Evaluation

Items	Description
Description	Program providers are to conduct self-assessment regarding each program delivered
Scope	Project-level evaluation with formative purpose (*i.e.*, what can be improved?)
What do we want to know	• How well was the program implemented to meet the SSP intended objectives? • Did the program meet the overall KPIs? • What worked and what did not?
When data will be captured	Before and after an event is implemented
Who will capture the data	Each program provider
Estimated cost	Inclusive in program delivery
Method	Primary data collection of both quantitative and qualitative data. Qualitative data is gathered through questionnaires and surveys.
How we will know (indicators)	This evaluation is based on Key Performance Indicators agreed between SSP and each program provider. An example of the form is provided in Appendix 5. <u>Quantitative (output)</u>: number of events; number of schools participating; number of students participating <u>Qualitative (outcomes)</u>: • student and teacher feedback on the pre- and post- event questionnaires • representative quotes by students and teachers on their experience in participating in a specific event • a specific, open-ended question regarding student understanding of particular key concepts introduced through the STEM activities
How will it be reported	Program providers will provide a written report to the SSP program team
Benefits for reporting	• Reflect to improve the effectiveness of the program • Provide 'stories and quotes' for case studies • Inform the outcomes-based evaluation
Alignment with program logic model	• Quantitative data will be aggregated to assess progress toward the output target • Qualitative data will provide early indications on short and middle term outcomes
Risks	• The evaluation will rely on the program provider and methodology and data might be biased toward the needs of the program provider

Table 7: SSP program sponsor evaluation

Items	Description
Description	• To observe how STEM programs are implemented • To ensure programs are delivered with high standards & meet KPIs (accountability) • To advance community engagement • To advance reputational benefits - a showcase of program ownership
Scope	Internal evaluation to inform future iterations of the program (formative purpose)
What do we want to know (non-expert impressions)	• How well do the programs appear to be designed and implemented? • Do the programs appear to be cost effective? • Is student engagement seen to be self-sustaining, or does it appear to require continued intervention? • Do the programs seem to contribute to the overall goals of the SSP?
When data will be captured	• Schedules will be discussed amongst the SSP program team (industry sponsors and DETE) to attend an event or visit a school once or twice per year by staff of each sponsor
Who will capture the data	• Industry sponsors • Project Management: DETE
Estimated cost	Inclusive as part of the individual role (additional travel costs might be allocated)
Method	• Direct observations • Informal interviews
How we will know (indicators)	• Refer to the Key Selection Criteria Table 4 and observe how well providers deliver the educational program. • Short informal conversations with participants involved in the event can gather on-site opinions and perceptions.
How will it be reported	• Representatives of each sponsor will document their visits in the form of field notes that will be shared with other members of the SSP program team • Representative of DETE who performs as the project manager will collect and compile evaluation reports
Benefits for reporting	• Appreciate the apparent effectiveness of the program in its delivery context and identify issues immediately • Immediate internal reporting to management
SSP program logic matrix	• To ensure implementation of STEM programs is on target • To adapt and enable changes if needed to meet KPIs and contribute to the achievement of SSP objectives and goals • To inform future program selection based on perceived needs of schools and key stakeholders • To inform the outcomes-based evaluation.
Risks	• Stakeholders may use these opportunities to approach industry sponsors with their wish list of programs.

5.3.2 Summative evaluation: outcomes-based

The summative evaluation is conducted to assess the outcome (or possible impact), the progress toward specific, measurable goals that have been agreed to by the SSP program team. Results will comprise data that has been collected over the duration of the program. A summative evaluation can assist program sponsors to learn from their program interventions. Recent literature suggests that "*philanthropists have an obligation to learn*" (PhilanthroFiles, 2014). This learning can be done through evaluation activities that aim to generate good information on how the interventions have occurred to date, ascertaining what has been successful and what needs to be improved.

Under this type of evaluation, CSRM researchers suggest the model of outcomes-based evaluation with detailed information provided in the Table 9. The outcomes-based evaluation can articulate where changes among students have been engendered by the suite STEM enrichment programs supported by the SSP. The hierarchy of intended outcomes of the SSP to be measured is provided below, as highlighted in the SSP program logic matrix (Table 8).

Table 8: Outcomes hierarchy

Ultimate goals / Outcomes	*Refer to the SSP program logic matrix (light purple colour)*
Intermediate outcomes for students Year 11 and 12: "Challenge and prepare"	○ Students complete high school both **intending to study and able in STEM** ○ Students **understand the connections across STEM and between STEM and other subjects** ○ Students complete high school **ready for college and technical training** ○ Students are **aware of STEM career opportunities and pathways** ○ High achieving students in STEM reflect all population groups
Intermediate outcomes for students from Year 7 to Year 10: "Make connections"	○ Students are **interested and confident** in STEM ○ Students **understand connections** across STEM, and between STEM and other subjects ○ Students **consider STEM careers** while making important STEM subject choices ○ Students **have the STEM skills** necessary to succeed in workforce training programs ○ High achieving students in STEM reflect all population groups
Intermediate outcomes for students Year 5 and 6: "Stimulate interest"	○ Students are **inspired** and confident in STEM ○ Students **aware** about options in STEM careers ○ High achieving students in STEM reflect all population groups

Table 9: Outcomes-based evaluation

Items	Description
Description	Outcomes-based evaluation is conducted to understand changes in students created by the suite of STEM enrichment programs supported by the SSP
Scope	Outcomes based evaluation for summative purpose
What do we want to know	What did the SSP and its STEM enrichment program achieve? How or why did the STEM program achieve its results? (to evaluate implementation and outcomes) Have the programs contributed to social change (greater 'science capital') in the region?
When data will be captured	Annually –plan will be detailed once the span of the evaluation program (budget) is finalised
Who will capture the data	Independent evaluator
Estimated cost	Based on an individual negotiation Common budgets range from 5% (low end) to as much as 20% (top end) of the total funds allocated for the program. A major aspect of determining the budget is identifying and estimating the various components of evaluation.
Method	• Quantitative data tracking to follow trends in STEM enrolments • Establish student cohort for a longitudinal study *Detailed methodology including the questionnaires are discussed in later sections and provided in the appendices.*
How we will know (indicators)	Semi-structured questionnaires and surveys have been prepared for key respondents: • Teachers and principals • Student parents • Students within three targeted groups
How will it be reported	A written report will be provided by an independent evaluator based on the longitudinal study; the report will also summarise other project-level evaluations.
Benefits for reporting	• To understand how the SSP STEM programs and other input factors have contributed to the achievement of the intended outcomes • To justify the programs to external audiences
The alignment with program logic model	• To inform and adjust future SSP design and its program logic model • To look for and explore unintended outcomes or consequences of the STEM enrichment programs and relationships to other parts of the SSP offerings.
Risks	• Evaluation fatigue: participants, whether children or adults, can tire from too many survey and data requests, which can result in data collection problems • Data overload: excessive amounts of information gathered without sufficient time to process results.

5.3.3 Baselines

Measuring the outcomes and collecting data

To demonstrate the effect and impact of a program, it is important to have a pre- and post- comparison of the SSP. Therefore, to construct an evaluation framework, CSRM researchers must establish baseline data and information (as identified in Chapters 2 and 3). The baselines obtained during this study have captured initial feedback from respondents representing schools that have received the SSP programs. Similarly, quantitative data has been collected to demonstrate current trends of students taking STEM subjects and what they are destinations are – in study or work - after they complete Year 12.

The data collection has been designed to employ both quantitative and qualitative data collection. Quantitative data will be collected through student surveys for each target group. Survey questionnaires were developed based on questions that are publicly available and that have been used and tested for other similar evaluation purposes (Friday Institute of Education Innovation, 2012; MLA, 2008; and King's College London, 2013). Adjustments were made to suit the local context of the region of study from the input received during the October 2014 school visits. The survey questionnaires that have been developed to date include:

- Survey questionnaires (Year 5-6) provided in Appendix 6
- Survey questionnaires (Year 7-10) provided in Appendix 7
- Survey questionnaires (Year 11-12) provided in Appendix 8.

Questionnaires designed for students have to be tailored and tested to assure that they work for students at the designated year levels. For example, questionnaires for students in Years 5-6 need to avoid complicated sentences and abstract questions. Ambiguity in terminology can also be a challenge. For example, is a question about how much a student likes 'science' meant to be about science as one of the topics that they study in school (reflecting also how it is taught) or about science in a more abstract sense, relating to knowledge of the physical and biological world? One needs to determine whether a Likert-scale response is appropriate, as younger students are generally less experienced in providing such responses. Students in rural and regional areas may have less experience encountering such surveys on the internet, as internet speed and availability are not as high as in urban areas.

Semi-structured questionnaires have been developed for interviews of school teachers/ principals and students' parents (Appendix 9 and Appendix 10). CSRM researchers have tested these questionnaires during the October 2014 for four selected schools. The questionnaires were designed to ensure an interview of between 30 minutes and one hour. Results from the interviews form baseline qualitative data; however, other qualitative data can be collected through focus groups or observations.

A longitudinal study is proposed to track changes that may occur for students as a result of the STEM enrichment programs. The suggested design of the longitudinal study is provided in Table 10. It is important to note that an evaluator needs to engage with the schools and that a detailed plan is required prior to the implementation of the longitudinal study. The design and factors involved in the longitudinal study will depend on budget availability and timeframes for this outcomes-based evaluation. Each of these domains will be subject to the agreement between the SSP program team and a potential evaluator. That said, survey forms and target numbers of students to be surveyed are outlined in the appendices of this report.

An evaluator needs to work closely with the SSP sponsors, local and state education agencies, and school principals. It is important for a potential evaluator to receive all approvals and consents prior to the implementation of data collection.

The development of a solid stakeholder relationship with DETE representatives is important to ensure appropriate collection of time-series data on student enrolments and destinations. The electronic databases containing the time-series data set will be provided to the SSP program team as part of this report. These data include:

- The percentage of students in Years 10, 11 and 12 studying a STEM subject within the region.
- Next Step Survey: destinations of Year 12 completers – this database captures STEM fields of study of Year 12 completers from the region undertaking an apprenticeship or traineeship and university, by local government area and school from 2008 – 2014.

Importantly, this data needs to be compared to a benchmark given the many factors that can influence enrolments and career destinations. An overall national trend in Australia of declining enrolments (discussed earlier in this report) may not be arrested by a single suite of STEM enrichment programs. However, such programs can play an important role in school-wide and system-wide efforts. The target for the SSP in the near term should be to close the gap between country and city in the percentage of students studying STEM and heading for STEM careers. The literature – and interview results – suggest that students in many urban and suburban areas would encounter a richer selection of courses, more experienced science teachers, and more opportunities for extra-curricular engagement on STEM topics.

Table 10: A longitudinal study design

Primary schools (Year 5 - 6)	High Schools (Y10 and Y 12)
Working together with DETE to invite primary schools to participate with criteria: - a school located in the regional centre - a school located in a rural area - representative of different size of schools	4 high schools to start immediately
Student survey (in each school): 50 % of Y5 50 % of Y6	Student survey: All Year 10 Students All year 12 Students
Interviews with: Principals and teachers teaching science and mathematics	Interviews with: Principals; teachers (STEM teachers and Heads of department); parents
Questionnaires have been drafted: Teachers/principals Students survey (Y5 & Y6)	Questionnaires have been drafted: Teachers/principals Students survey (Y10 and Y12)

Analysing and interpreting data and findings

Typically the evaluator is responsible for analysing data and findings from the STEM program. The SSP sponsors will also be consulted in order to contextualise the results. Overall, analysis should be framed by the evaluation questions and outcomes that are identified in this report. However, there should be room to look for and explore unintended outcomes or consequences of the STEM enrichment programs.

One also needs to attend to external factors that can affect outcomes. For example, for the SSP, other research is showing a high level of migration into and out of the target region. That can cause overall figures in STEM enrolments to fluctuate based on the predispositions and preferences of the students who happen to be attending school in this region in a given year. A significantly different selection of students may be attending in the subsequent year.

It is also important to take into account schooling practices in the region. In this region, students from families with higher socioeconomic status tended to be sent to a regional centre for urban centre for boarding school in their upper years. So, differences in STEM enrolments between Years 5-6 and Years 11-12 may reflect which families keep their children in local schools.

Given these cautions, the analysis and report should at least identify patterns or commonalities, make comparisons or contrasts, and in some cases, examine causation and attribution. The program logic matrix should be used as a core reference point.

Ultimately, the evaluation elements should enable refining the programs on offer, identifying which programs to renew or selecting alternative programs, and identifying opportunities for synergies with state-sponsored or federal programs in the STEM area.

6. Conclusions and recommendations

Data demonstrates that participation in STEM subjects has been falling over time. As the SSP has been operating over only a short period, it is not possible to determine each enrichment program's effectiveness in alleviating or reversing this trend. Participation in STEM is influenced by a range of factors including the limited availability of highly trained and motivated teachers, student perceptions that STEM subjects are harder, and support in the home and broader community. These factors tend to be exacerbated in rural areas, such as the DDSW region.

Tracking data in relation to long-term effectiveness of the SSP program is challenging due to the limited data that is collected on an ongoing basis about student destinations after their schooling ends. Therefore, a focus needs to be on tracking student retention in STEM subjects across each phase of schooling – years 5-6, years 7-10, and years 11-12. This output-based data will ideally be supported by gathering qualitative data through structured surveys that identify students' perceptions of the SSP Program's effectiveness.

Further, tracking trajectories over time and understanding the factors that influence a small cohort's interest in STEM subject selection could be ideal. While this approach represents a higher cost outcome, it can provide useful, outcome data over time.

While limited data is available in the absence of higher-cost evaluation exercises, there is a strong body of evidence about what constitutes successful program interventions. An option is for the SSP Program to more tightly constrain funding for the delivery of a program to those programs that demonstrate the closest alignment with these best practice criteria. Requiring delivery partners to conduct meaningful evaluations both before and after delivering a program will give further evidence over time about the SSP's effectiveness.

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Appendices

Appendix 1: STEM classification based on the One School Corporate Reporting (OSCR) as provided by the QLD DETE

Science	Technology	Engineering	Mathematics
Aerospace Studies	Accounting	Engineering Studies (4 Semester)	Introduction to Mathematics C
Agricultural Science	Agricultural Mechanics	Engineering Technology	Mathematics
Agricultural Practice	Agricultural Science	Engineering	Mathematics - Industrial Skills
Agricultural Science	Agricultural Science One	Introduction to Engineering & Furnishing	Mathematics (Senior) – Foundation
Agricultural Studies	Automotive Studies (4 Sem)		Mathematics A Senior Preparation
Agriculture & Horticulture	Building & Construction Studies (4 Sem)		Mathematics B Senior Preparation
Animal Studies	Business Technologies & Communication		Mathematics Extension
Introduction to Agricultural Studies	Business Technologies and Communication		Mathematics Vocational Skills
Rural Practices	Introduction to BCT		Numeracy
Rural Studies - SEP	Graphics		Numeracy MAP
Study Agriculture	Industrial Graphics (4 Sem)		Practical Mathematics
Agricultural and Horticulture	Industrial Technology Studies		Pre vocational Maths for Year 10
Biology	Industrial Technology Studies (2 Sem)		Prevocational Mathematics
Chemistry	Certificate in ICT		Pre-Vocational Maths - SEP
Earth Science	Information Processing and Technology		QCIA Numeracy
Physics	Robotics		Mathematics A
Alternate Science	Technology		Mathematics B
Biology	Information Processing and Technology		Mathematics C
BSDE Biology	Applied Design and Technology		Prevocational Mathematics
BSDE Physics	CAD Operations		
Chemistry	Graphics		
Design Automation and Technology	Graphics and Design		
Environmental Education	Graphics for Living		
Flexi School Science	Graphics/Tech Studies		
Introduction to Biological Science	Industrial Graphics		
Introduction to Chemistry	Industrial Technology (Manufacturing)		
Introduction to Physics	Industrial Technology and Design		

Science	Technology	Engineering	Mathematics
Life and Environmental Science	Industrial Technology Studies		
Physical Science	Product Design and Manufacture		
Physics	Product Manufacture and Design		
Science	Shop A		
Science - Biology and Chemistry	Shop B		
Science - Foundation	Technology Studies		
Science - Physics and Earth Science			
SCIENCE (SEP)			
Science Experience			
Science Extension			
Science Foundation			
Science in Practice			
Science Studies			
SOSE and Science Program			
Super Science			
Year 10 Science			
Science in Practice			
Science21			

Appendix 2: Field of study in higher education as provided in the QLD DETE Next Step Survey

Field of Study	Examples
Natural and Physical Sciences	Science, Applied Science, Laboratory Technology, Biomedical Science, Forensic Science
Information Technology	Information Technology, Network Engineering, Software Design, Web Design
Engineering and related technologies	Engineering, Automotive mechanics, Electro Technology, Refrigeration, Aviation, Electrical Apprenticeship
Architecture and Building	Building, Architecture, Carpentry, Interior Design, Regional and Urban Planning, Surveying
Agriculture, Environmental and Related Studies	Horticulture, Land Management, Environmental Science, Agricultural Science, Marine Studies
Health	Nursing, Sport Science, Occupational Therapy, Medicine, Pharmacy, Fitness, Physiotherapy
Education	Primary education, Secondary Education, learning management, early childhood education
Management and commerce	Business, Accounting, Business Management, Commerce, Tourism, Real Estate, Marketing
Society and Culture	Law, Arts, Youth Work, Journalism, Social Science, Psychology, Social Work
Creative Arts	Fine Arts, Visual Arts, Music, Multimedia, Graphic design, Performing Arts, Photography
Food, Hospitality and Personal Services	Hospitality, Hotel Management, Hairdressing, Kitchen Operations, Commercial Cookery
Mixed Field Programs	Adult Tertiary Preparation, Creative Industries, Vocational Skills Development, Bridging Courses
Double Field of Study	University Students undertaking double degrees (e.g., Business/Biotechnology)

Appendix 3: STEM and non-STEM occupation types as provided in the QLD DETE Next Step Survey

[a] 2008 – 2012 STEM occupations	Other Occupations
Building and Construction Skilled Workers	Sales Assistants
Electrical and Electronics Trades	Food Handlers
Metal and Engineering Trades	Waiters
Automotive Workers	Clerks, Receptionists and Secretaries
Engineering and Science Related Workers	Food, Hospitality and Tourism Workers
Computing and IT Workers	Health, Fitness, Hair and Beauty Workers
	Child Care and Education-related Workers
	Laborers
	Accounting, Finance and Management
	Gardeners, Farmers and Animal Workers
	Store persons
	Drivers and Transport Workers
	Cleaners
	Marketing and Sales Representatives
	Factory and Machine Workers
	Government and Defense
	Media, the Arts and Printing Workers
	Social, Welfare and Security Workers
	Pamphlet/Paper Delivery Workers
[b] 2013 – 2014 STEM Occupations	
Building and construction	
Mechanics	
Electrician	
Electronic and electronic instrument	
Communications	
Plumbers	
Drillers	
Chemical, petroleum and gas plant operators	
Power generation plant operators	

[a] Field of study categories based on the Australian Bureau of Statistics' Australian Standard Classification of Education.
[b] 2013–2014 occupation categories based on the Australian Bureau of Statistics' Australian and New Zealand Standard Classification of Occupations.

Appendix 4: Review of STEM programs and the potential impacts on young people's engagement in STEM subjects

Programs, example activities and relevant literature	Learning principles, aims and instructions - 'success factors'	How the output/outcome is evaluated	Source (*sponsors, providers or links*)
BG Group Science enrichment programs (BG group has invested in science enrichment programs throughout the world and compiled a report on their success factors): • Visit companies working in STEM-related industries • Conduct summer school programmes offering practical science experiences • Conduct classroom-based talks or workshops delivered by experts in STEM subjects	Students most effectively engaged through provision of **practical learning** activities which are **stimulating, enjoyable, and related to the world of work, daily life and their local context**.	Not specified	BG Group
• Enhance in-school science with investigative approaches related to the local environment (in Brazil) • Combine outdoor field trips and curriculum-related workshops in school (in the UK).	Engaging and challenging students through **interactive scientific enquiry and problem solving.** This is consistent with Minnesota program (State of Minnesota).	Not specified	BG Group
• Conduct practical science activities delivered through 'Science Bus' visits to school sites (in Trinidad and Tobago) • Provide opportunities for students to visit Rio de Janeiro's Museum of Geo-diversity (in Brazil) • Conduct workshops at the Science Museum London (in the UK).	Engaging and challenging students through an **enriched curriculum**, including **informal learning and extra-curricular activities**, leads to positive outcomes. This is consistent with findings that shaped STEM teaching in Minnesota: '*Out-of-school-time experiences provide important opportunities for engagement in STEM*' (State of Minnesota)	Not specified	BG Group
• Conduct summer schools and bursary projects	Supporting young people to **develop their confidence and self-belief in STEM subjects** is beneficial, particularly for young people from disadvantaged groups and backgrounds	Not specified	BG Group
• BG Group STEM inspiration Bursary Programme – it is a specific program to motivate, encourage and improve students' academic and interpersonal skills to study and	Personal effectiveness sessions are designed to help students with learning styles, time management, self-confidence, communication and	Not specified	BG Group

Programs, example activities and relevant literature	Learning principles, aims and instructions - 'success factors'	How the output/outcome is evaluated	Source (*sponsors, providers or links*)
apply higher degree educations and consider STEM related careers with self-confidence	presentation skills, interview skills, university applications and STEM career advice		
• Provide "specialist science teachers training" to a wider group of 'teacher trainers' to use curriculum resources and cascade this learning in their own schools (in Thailand) • Develop a national STEM teacher network to support STEM teachers (in the UK) • Conduct teacher training workshops to help them teach critical and creative thinking in science (in Trinidad and Tobago)	It is important that **STEM teachers are supported** to continuously update their knowledge and skills and to maintain their passion for teaching	Not specified	BG Group
• Provide young people and their parents with information about STEM study options and career pathways	It is important that young people, and their families, are provided with **good quality information and advice on STEM study and career options** and the value of STEM qualifications.	Not specified	BG Group
"**SMART: our education portal**" - SMART stands for Study, Mining and Rio Tinto. It is a portal that is developed to assist young people to make the connection between what they learn at school and the careers they can follow later in life. 'SMART is free to use and supports classroom teaching and learning in maths, science and business studies for young people aged 12-16. Source: http://ebceducation.co.uk/	The program assists students to explore how their academic studies relate to real-world operations in a major global business by combining interactive teaching/workshop methods such as: interactive whiteboard presentations, printable lesson plans, worksheets and case studies.	Not specified	Sponsored by Rio Tinto and developed by EBC Education
"**BHP Billiton Science and engineering awards**" – The awards are provided for students (young people who have undertaken practical research projects which demonstrate innovative approaches and through scientific procedures) and teachers (teachers who have outstanding performance and contributions in teaching and for their support to students investigations). Source: http://www.scienceawards.org.au/benefits_of_the_awards/	The awards provide a platform for students to demonstrate ingenuity, inquisitiveness, excellence in experiment design and application to problem solving. It is important to have fun while doing experimental projects so students can show their creativity and aptitude for lateral thinking in devising and doing their research.	It is a straightforward program whereby awards are given through competitive processes of an annual open competition.	Sponsored by BHP and managed by CSIRO since 1981

Programs, example activities and relevant literature	**Learning principles, aims and instructions - 'success factors'**	**How the output/outcome is evaluated**	**Source (*sponsors, providers or links*)**
	Teacher awards allow teacher to set themselves apart as educators with special skills who inspire their students to seek knowledge.		
Shell Questacon Science Circus, Shell and ANU - It is an outreach program as part of the Questacon activities in a collaboration with the Master of Science Communication Outreach - ANU. Activities include: - in-school show performances - teacher professional development workshops - a travelling science centre for the community - beyond school events for senior secondary students Source: https://www.questacon.edu.au/outreach/programs/science-circus/studying-science-circus/stories-from-the-road	Inspiring locals with wonder of science	Stories and quotes	Sponsored by Shell and conducted by the Australian National University (ANU)
"**Robo Cup Junior Australia**" supports local, regional and international robotic events for young students. The program aim is to encourage young people to take an interest in scientific and technological fields through robotic competitions. Source: http://www.robocupjunior.org.au/	The program seems fun and promotes interactive events. It is organised at Universities, which creates a good first contact with tertiary education	Not provided	Robo Cup Junior Australia website
"**Opti-minds**" – conducts regional challenges (14 regions throughout Queensland) in language literature, science engineering and social sciences. Source: http://opti-minds.com/	It is important to promote pro-active mindset: • Capability – 'can do!' • Responsibility – 'if not me – then who?' • Creativity and Innovation within participants, support them to realise their capacity and responsibility to make a difference for themselves and to come from an 'if not, why not? stance.	Student quotes	Sponsored by UQ Gatton, BHP Billiton and Handybin Waster Services and JCU.
"**Carnegie Academy for Science Education (CASE)**" promotes several programs such as: • *First light* – students learn science by doing science. It is a free Saturday Science School for grades 6 to 8.	Empowering children to ask questions, to have basic analytical skills and broaden educational and career horizons	Not available (the CASE has been used by some schools in Australia – evidence	Sponsored by several private sources and the US National Science Foundation.

Programs, example activities and relevant literature	Learning principles, aims and instructions - 'success factors'	How the output/outcome is evaluated	Source (*sponsors, providers or links*)
• *SciLIFE-DC* – an outreach partnership to co-host an event with the Department of Forensic Sciences at George Washington University • *CASE STEM Kits* – are available for teachers completing 3-hour certification session for each kit • *DCBiotech* – provides interships for DC high school students at various US departments • *Math for America DC* – has two components: fellowship program (for new teachers and 15 months of an intensive training program) and the master teacher program (experienced teachers). Source: https://case.carnegiescience.edu/	Instituting lasting change in the DC schools through teachers professional development programs and student programs	found during the fieldwork in October 2014)	
"**UQ Young Scholars Program**" - high-achieving year 11 students are being given the chance to experience university life through the University of Queensland's Young Scholars Program (YSP), which also includes residential camps over Years 11 and 12 at UQ's St Lucia campus. Source: http://www.uq.edu.au/youngscholars/index.html	The program provides opportunities to students on immersion experience; a group experience which includes making friends and challenging students to think critically about today's major global issues; exposing students to a wide range potential study areas and career opportunities	Not available	UQ
Minnesota early childhood program Source: http://www.mncompass.org/education/stem/support-early-learning	It is suggested that STEM programs starting at early– primary schools or even pre-school *STEM instruction capitalizes on students' early interest and experiences, identifies and builds on what they know, engages them in STEM practices, and provides them with experiences to sustain their interest*." Key elements that contribute to effective STEM instruction include: • coherent set of standards and curriculum • teachers with high capacity	Minnesota Programme	State of Minnesota

Programs, example activities and relevant literature	Learning principles, aims and instructions - 'success factors'	How the output/outcome is evaluated	Source (*sponsors, providers or links*)
	• supportive system of assessment and accountability • adequate instructional time equal access to quality STEM learning opportunities		
Minnesota Linking Youth and Families with STEM Source: http://mn-stem.com/stem/	Programs that focus on building science capital with students and families	Minnesota Programme	State of Minnesota
King's College London Study National Research Council, Successful K–12 STEM education: Identifying effective approaches in science, technology, engineering, and mathematics	Key useful lesson learnt for learning: • Breaking the 'science = scientist' link • Embed STEM careers awareness in science lessons • Tackle multiple inequalities so that students can think 'science is for me', not just white middle class male • Bust the 'brainy' image of science/science careers	**It is a 5 year evaluation project, not a specific STEM program** - it provides key parameters to assess outcomes from STEM enrichment programs	King's College London Study
ATSE Wonder of Science – the program is to build passion and enthusiasm for science and technology for students in Years 6 to 9. It aims to provide opportunities for young people and generate greater numbers of young science and engineering graduates in the near future. Source: http://wonderofscience.com.au/	Alignment of the program with the Australian Curriculum and an inquiry-based pedagogical approach Using young ambassadors and industry ambassadors Encouraging investigative science through teamwork and collaboration	A survey for the pre and post event and provide 'success story'	The Academy of Technological Sciences and Engineering (ATSE) with several private sponsors including QGC, Santos, Origin/APLNG and Arrow Energy

Programs, example activities and relevant literature	Learning principles, aims and instructions - 'success factors'	How the output/outcome is evaluated	Source (*sponsors, providers or links*)
Power of Engineering – the program is to inspire young people, particularly females and regional students to consider a diverse and creative career in engineering and to transfer the community perceptions of the profession. It is an event that is designed for students at Years 9 and 10 before they make senior subject selections. Source: http://wonderofscience.com.au/	Inspiring students is the key message from this program Networks of people through events and workshops that shift the perception of engineering	A survey for the pre and post event – it provides 'success story' and statistical information of impacts **"% of students change their mind from not consider-ing a career in engineering to con-sidering it**	A collaborative organisation: Engineers Australia, The QUT and AECOM
Apollo program - is designed for high-achieving students. The program has four projects: the **Archimedes project (STEM initiative)**, the Aristotle project, the Aeschylus project and the Chronos project. The guideline can be retrieved at this link: https://dalbyshs.eq.edu.au/Supportandresources/Formsanddocuments/Documents/stem-%20program.pdf	Gaining an understanding of the underlying principles of engineering, aviation and aerospace in its broadest sense. Combining the application of fundamental principles from many disciplines (mathematics, science, English, ICT, engineering and history)	The program provides a checklist questions for teachers and parents to access student performance	Sponsored through STEM Enrichment Partnership (QLD DETE and QGC, Arrow Energy, Santos and Origin/APLNG) conducted by Dalby State High School Source: https://dalbyshs.eq.edu.au/Curriculum/Specialistprograms/Pages/Apollo-program.aspx

Programs, example activities and relevant literature	Learning principles, aims and instructions - 'success factors'	How the output/outcome is evaluated	Source (***sponsors, providers or links***)
F1 – The Formula 1 Technology Challenge – is the world largest Science, Technology, Engineering and Mathematics (STEM) competition. Students as young as 10 are designing, testing and making miniature F1 cars capable of 80 km/h.	It is a holistic action learning program focuses on developing long term employability skills. The program encourages leadership, team building, project management, business planning, public speaking, marketing, collaboration, writing and presentation skills	The success is determined through the winner of the competition and will compete at the international competition	Australian Govern-ment Department of Defence (Defence Materials Organ-isation), Autodesk, Nordon Cylinders, CAMS. SSP has supported some schools to be able to join the F1 competition. Source: http://rea.org.au/f1-in-schools/
The state of Minnesota has supported the development of a great variety of STEM enrichment programs for different age groups. More details are available on the website of the State of Minnesota STEM programs.	According to the State evaluation: '*Instruction in advanced courses should engage students in* ***inquiry through experiments****, analysis of information, critical consideration of the validity of findings, and the* ***solving of problems both individually and in groups***' '*Out-of-school-time experiences provide important opportunities for engagement in STEM*' (State of Minnesota)	Multiple evaluation methods and state monitoring	State of Minnesota STEM programs.

Appendix 5: Key Performance Indicators form

Description	Performance Indicators	Source and means of verification	Risks/Assumptions
Goal or impact			
Purpose or outcome			
Outputs			
Activity			

To be completed by the SSP Project Management and selected program providers

Appendix 6: Example questionnaires for students in Years 5 -6

NOTE: *The below questionnaire provides an example that should adapted to suit the context of the schools and students to be surveyed. This adaptation should be undertaken with careful consideration at the outset to maintain the same questionnaire across schools and through time so that trends can be evaluated.*

Furthermore, questions from the set given below need to be selected and pilot tested to assure that they suit the year level, degree of sophistication, and attention span of the students to be surveyed. The surveys, as provided below, are too long and too wordy, but they suggest the range of topics on which students can be surveyed.

Student Attitudes toward STEM: Year 5 and Year 6

Directions:
Please mark how you feel about each statement. For example:

Example 1:	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
I like mathematics.	○	○	✓	○	○

There are no "right" or "wrong" answers! The only correct responses are those that are true *for you*. Whenever possible, let your experiences help you make a choice.

Please fill in only one answer per statement.

About Yourself

1. Are you?
   - ☐ Boy
   - ☐ Girl

2. Your school year:
   - ☐ Year 5
   - ☐ Year 6

3. Your school: ………………………………………………………………………….

4. How would you identify your family background? (optional)
   - ☐ Indigenous and Torres Strait
   - ☐ Anglo background
   - ☐ Asian background
   - ☐ African background
   - ☐ Others (*please specify your background* :……………………………………….)

Your thoughts about Mathematics and Science subjects

5. How do you find mathematics?

Statement	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
I can do well in mathematics.	○	○	○	○	○
I am not interested with mathematics	○	○	○	○	○
I will need mathematics for my future studies	○	○	○	○	○

6. How do you find science?

Statement	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
I won't take science in my senior grades	○	○	○	○	○
I will need science for my future work.	○	○	○	○	○
I know I can do well in science.	○	○	○	○	○
I am not interested in science	○	○	○	○	○

7. How well do you expect to do this year?

Class	Not Very Well	OK/Pretty Well	Very Well
English/Language Arts	○	○	○
Mathematics	○	○	○
Science	○	○	○

8. In high school, do you plan to study:

Class	Yes	No	Not Sure
Mathematics	○	○	○
Biology	○	○	○
Physics	○	○	○
Chemistry	○	○	○

9. Do you know any adults who work as:

	Yes	No	Not Sure
Scientists (e.g. biologist)	○	○	○
Engineers (e.g. electrician)	○	○	○
Mathematicians	○	○	○
Technologists (e.g. computer analyst)	○	○	○

10. Do you get support outside class in learning science and mathematics from:

	Yes	No	Not Sure
Your teachers (e.g. extra tutorial)	○	○	○
Your parents (e.g. doing homework)	○	○	○
Others (*please specify*): ……………………………	○	○	○

11. Please indicate which program you have participated in:

Program name	Yes	No	Not sure	When did you participate?
Wonder of Science (WoS)	○	○	○	
Power of Engineering (PoE)	○	○	○	
Other programs (please specify what is the program ……………………………………………)	○	○	○	

12. Your feelings about the programs (*<u>your answer for Question 11</u>*)

Statement	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
I learned new and interesting things	○	○	○	○	○
I can use what I learned at school	○	○	○	○	○
I learned about jobs and career options	○	○	○	○	○
I could make sense of most of the things introduced in the program					
I have decided to learn more science for my future job	○	○	○	○	○
I am inspired to consider jobs that use mathematics skills	○	○	○	○	○

13. Would you suggest that your friends participate in these programs?
- ☐ Yes (*which program*: ………………….………………….……………………….)
- ☐ No (*why not*: ………………………………….………………………………………………………………………..………………………………………………… ………………………………)
- ☐ Not sure

Thank you for completing this survey! We wish you all the best with school!

Appendix 7: Questionnaires for students Year 7 – 10

NOTE: *The below questionnaire provides an example that should adapted to suit the context of the audience. This adaptation should be done with careful consideration at the outset to maintain the same questionnaire across schools and through time so that trends can be evaluated. As noted above, questions are indicative and not all need to be used in one survey. Furthermore, the survey to be used needs to be piloted on students to assure that each question's meaning is correctly interpreted.*

<u>Student Attitudes toward STEM: Year 7 to Year 10</u>

Directions:

Please mark how you feel about each statement. For example:

Example 1:	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
I like engineering.	○	○	✓	○	○

There are no "right" or "wrong" answers! The only correct responses are those that are true *for you*. Whenever possible, let your experiences help you make a choice.

Please fill in only one answer per statement.

About Yourself

1. Are you?
   - ☐ Boy
   - ☐ Girl

2. What is your school year now? (Suggestion: to focus on Year 10)
   - ☐ Year 7
   - ☐ Year 8
   - ☐ Year 9
   - ☐ Year 10

3. What school do you attend? ....

4. How would you identify your family background? (optional)
   - ☐ Indigenous and Torres Strait
   - ☐ Anglo background
   - ☐ Asian background
   - ☐ African background
   - ☐ Others (*please specify*:…………………………………………………….)

Your thoughts about Science, Mathematics, and Engineering subjects

5. How do you find mathematics?

Statement	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
Mathematics has been my worst subject.	○	○	○	○	○
I can handle most subjects well, but I cannot do a good job with mathematics.					
I would consider choosing a career that uses mathematics.	○	○	○	○	○

6. How do you find science, technology and engineering?

Statement	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
I am confident when I do science.	○	○	○	○	○
I am good with technology subject.	○	○	○	○	○
I found science is not for me.	○	○	○	○	○
Knowing science will help me earn a living.	○	○	○	○	○
I like to imagine creating new products	○	○	○	○	○
I am good at building and fixing thing	○	○	○	○	○

7. How well do you expect to do this year in your class?

	Not Very Well	OK/Pretty Well	Very Well
English/Language Arts	○	○	○
Mathematics	○	○	○
Science			
Business	○	○	○
Others (*please specify*: ………………………………………………)	○	○	○

8. What is your plan after finishing year 10?

	Yes	No	Not Sure
I will study mathematics	○	○	○
I will study science or engineering (*please specify what area*: …………………………………………………………………………)	○	○	○
I will take senior subjects in Science (*please specify what the subject*: …………………………………………………………………………)	○	○	○
I will take apprenticeship or trainee program (*please specify what area*: …………………………………………………………………………)	○	○	○

9. What is your career plan?

…………………………………………………………………………………………………

…………………………………………………………………………………………………

10. Do you plan to further study at university?

- ☐ Yes (*please continue to Question 11*)
- ☐ No (*please continue to Question 12*)
- ☐ Not Sure (*please continue to Question 12*)

11. What field of study will you consider at University?

- ☐ First option:…………………………………………………………………………
- ☐ Second option:…………………………………………………………………………

12. Do you know any adults who work as:

	Yes	No	Not Sure
Scientists (e.g. biologist)	○	○	○
Engineers (e.g. electrician)	○	○	○
Mathematicians (e.g. statistician)	○	○	○
Technologists (e.g. computer specialist, game developer)	○	○	○

13. Do you get support outside class in learning science, mathematics and engineering subjects from:

	Yes	No	Not Sure
Your teachers (e.g. extra tutorial)	○	○	○
Your parents (e.g. homework)	○	○	○
Others (*please specify*: …………………………… ……………………………………………………………….	○	○	○

14. Which program (s) have you participated in:

Program name	Yes	No	Not Sure	When did you participate?
Wonder of Science (WoS)	○	○	○	
Power of Engineering (PoE)	○	○	○	
Try Trades (TT)	○	○	○	
Formula 1	○	○	○	
Apollo Archimedes	○	○	○	
Other programs (*what program*: ……………………………………………)	○	○	○	

<u>Your feelings about such programs based on your answers in Question 14</u>

15. Amongst the programs listed in Question 14, which <u>program did you like the most</u>?

………

16. What were the <u>highlights</u> of participating in that program (*refer to Question 13*)?

……………………………………………………………………………………………

……………………………………………………………………………………………

17. Describe the <u>impact</u> of the program (*refer to Question 13*) on your career choices.

……………………………………………………………………………………………

……………………………………………………………………………………………

18. Your feelings about a program that you participated in.

Statement	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
I <u>learned</u> new and interesting things from the program	○	○	○	○	○
What was the key thing that you learned:					
I learnt things that made me <u>change my mind</u> about something	○	○	○	○	○
What did you learn? (e.g., career, subject, or a fact):					
I am more <u>confident</u> about what I can do and achieve	○	○	○	○	○

Statement	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
Give an example of what you can do or achieve					
The program has given me lots to think about.	○	○	○	○	○
Give an example					
I can make connections between classroom learning and solving real-world problems better than before the program.	○	○	○	○	○
Give an example					

19. Would you recommend that friends participate in such programs (refer to Question 13)?
    - ☐ Yes (*which program do you recommend most*:..)
    - ☐ No (*why not*: ………………………..…………………………………………………..)
    - ☐ Not sure

Thank you for your time in completing this survey!

Appendix 8: Questionnaires for students Year 11 – 12

NOTE: *The below questionnaire provides an example that should adapted to suit the context of the audience. This adaptation should be done with careful consideration at the outset to maintain the same questionnaire across schools and through time so that trends can be evaluated. As noted above, questions are indicative and not all need to be used in one survey. Furthermore, the survey to be used needs to be piloted on students to assure that each question's meaning is correctly interpreted.*

Student Attitudes toward STEM: Year 11 and Year 12

Directions:

Please mark how you feel about each statement. For example:

Example 1:	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
I like engineering.	○	○	✓	○	○

There are no "right" or "wrong" answers! The only correct responses are those that are true *for you*. Whenever possible, let your experiences help you make a choice.

Please fill in only one answer per statement.

About Yourself

1. Are you?
   - ☐ Boy
   - ☐ Girl

2. What is your school year now? (Suggestion: to focus on Year 12)
   - ☐ Year 11
   - ☐ Year 12

3. What school do you attend?

……………………………………………………………………………………………………

4. How would you identify your background (Optional)
   - ☐ Indigenous and Torres Strait
   - ☐ Anglo background
   - ☐ Asian background
   - ☐ African background
   - ☐ Others (*please specify*:…………………………………………………………)

Your thoughts about Science, Mathematics, and Engineering subjects

5. How do you find mathematics, science and engineering*?

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
I am confident in doing mathematics	○	○	○	○	○
I can make connections between mathematics and other subjects	○	○	○	○	○
I have advanced skills to apply mathematics for studying at university	○	○	○	○	○
I am aware of job opportunities and pathways that will use mathematics skills and knowledge	○	○	○	○	○

6. How do you find science and engineering*?

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
I can handle most subjects well, but I cannot do a good job with science	○	○	○	○	○
I am aware of job opportunities and pathways that will use science skills and knowledge	○	○	○	○	○
Science will be important to me in my life's work.	○	○	○	○	○
I have advanced science skills to study at university	○	○	○	○	○
I would like to use creativity and innovation in my future engineering work	○	○	○	○	○
When I finish my high school, I am ready to go to university or technical training programs using mathematics and science skills to be an engineer	○	○	○	○	○

* *Engineers use mathematics, science and creativity to research and solve problems that improve peoples' lives, and they invent new products*.

7. What is your career plan, what future jobs are you considering?

…………………………………………………………………………………………………

…………………………………………………………………………………………………

8. Do you plan to further study at the university?

- ☐ Yes (*please continue to Question 11*)
- ☐ No (*please continue to Question 12*)
- ☐ Not Sure (*please continue to Question 12*)

9. What field will you likely to study at university?

- ☐ First option :…………………………………………………………………..
- ☐ Second option:…………………………………………………………………..

10. Do you know any adults who work as:

	Yes	No	Not Sure
Scientists	○	○	○
Engineers	○	○	○
Mathematicians	○	○	○
Technologists	○	○	○

11. Do you get support outside class in learning and studying science, mathematics or engineering subjects from:

	Yes	No	Not Sure
Your teachers (e.g. extra tutorial)	○	○	○
Your parents (e.g. brainstorming on ideas)	○	○	○
Others (*please specify*): …………………………… …………………………………………………………………..	○	○	○

12. If you participated in the program, please indicate which program:

Program name	Yes	No	Not Sure	Could you recall when did you participated:
Wonder of Science (WoS)	○	○	○	
Power of Engineering (PoE)	○	○	○	
Try Trades (TT)	○	○	○	
Formula 1	○	○	○	
Apollo Archimedes	○	○	○	
Other programs (what provide here what is the program …….…………………………)	○	○	○	

<u>Your feelings about the science and mathematics enrichment programs</u>

13. Amongst the programs in the Question 12, which <u>program do you like the most</u>?

……

14. What were the <u>highlights</u> of your experience participating in the program that you chose in Question 13?

………………………………………………………………………………………………

……………………………………………………………………………………………..

………………………………………………………………………………………………

15. As a result of my participation in the program (*please specify*……………………………………………….), I understand more about

………………………………………………………………………………………………

………………………………………………………………………………………………

………………………………………………………………………………………………

16. Describe <u>the impact</u> of this chosen program on your view of career choices (*please write a short answer in the provided space*).

……………………………………………………………………………………………..

………………………………………………………………………………………………

………………………………………………………………………………………………

………………………………………………………………………………………………

17. Please answer in relation to your feelings on participating in the Programs as referred to Question 12.

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
The Program: (*please specify*: …………………………………………) has enriched and improved my academic skills (e.g. ability to answer exam questions, etc)	○	○	○	○	○
Give an example					
I have gained specific practical skills (e.g. fixing things, creating things, etc) during my participation in the program (*please specify*…………………………)	○	○	○	○	○

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
What practical skills have you gained?					
I am able to talk about something I have learned here with others, and I can understand their ideas	○	○	○	○	○
Give an example					
The program (*please specify*: ……………………………………………) has given me lots to think about.	○	○	○	○	○
What is an example of what you think about?					

18. Would you recommend that friends participate in such programs (refer to Question 12)?
    - ☐ Yes (*which program do you recommend most*:..)
    - ☐ No (*why not*: ………………………………………………………………………)
    - ☐ Not sure

Thank you for your completing this survey!

Appendix 9: Questionnaires for teachers/principal

NOTE: *The below questionnaire provides an example that should adapted to suit the context of the audience. This adaptation should be done with careful consideration at the outset to maintain the same questionnaire across schools and through time so that trends can be evaluated. The selected questions should be piloted to assure that they are understood as intended.*

INTERVIEW QUESTIONS: Principals and Teachers

About the school and teacher

1. Please tell us about your school
    a. What are the strengths of your school?
    b. What challenges has your school faced?

2. Your role as a teacher ……
    a. Can you please tell us about your role? What do you teach? What else do you do in the school?
    b. How long have you been in this role? How long have you been teaching overall?
    c. What grade(s) do you mostly teach?

3. Tell us about student trends in the last 5 or 10 years:
    a. Students taking science subjects (physics, chemistry, biological science, human biological sciences, earth & environmental science)
    b. Students taking mathematics subjects
    c. Students take up engineering subjects, *if any*
    d. Students taking technology subjects – *if any*
    e. Graduates with STEM in academic stream
    f. Graduates with STEM in vocational stream

4. What do you see as a trend among students in selecting destinations - to university / VET / training / employment - that are related to STEM? Up in the past 5 years? Down? The same?

Teaching STEM

5. In general, what are your views about teaching capabilities in STEM? (the extent to which educational background matches with teachers' responsibilities in teaching STEM; how confident are teachers in teaching STEM?)

6. What are your top three biggest challenges in teaching (or learning) about STEM topics?

7. What would you like to see changed in how you teach STEM? (e.g., more useful IT?)

8. What resources are available to support your job in the teaching of:
    a. Science - how about their quality?
    b. Technology - how about their quality?
    c. Engineering (*if any*) - how about their quality?
    d. Maths - how about their quality?

9. What programs are available for you (and other teachers) to improve the teaching knowledge/capabilities/skills?

About students: learning STEM and pathways to STEM careers

10. How do students seem to respond to STEM subjects? Do they seem interested, comfortable, enjoying themselves?

11. What factors seem to influence or help students to learn in STEM, specifically to take STEM subjects
    a. Parental support
    b. Teachers
    c. Student's background (gender, ethinicity, indigenous, social status, etc)
    d. Student's prior learning experiences
    e. Peer support and encouragement

12. Based on your observations, what factors seem to influence students to consider a pathway to a STEM career? (*optional question*)
    a. Parents support
    b. Teachers
    c. Student structural factors (gender, ethnicity, indigenous, social status, etc)
    d. Student positive/negative perception about science
    e. Peer support

Enrichment Programs

13. How has your school been involved in enrichment programs:
    a. What were the events?
    b. Who were the providers?
    c. What is your understanding of the aims of the event?
    d. Were you actively involved in the event? What was your role?

14. What are your views on strengths and weaknesses of the STEM enrichment programs?
    a. Do you think the program content (and provision of resources) is closely linked to the current STEM curriculum? How so?
    b. Did the program employ practical learning activities (hands on /connected to daily life and local context?
    c. Through your observations (and feedback received) about the program, were students/teachers actively engaged? Challenged with new ideas? Stimulated to think? (An example?)
    d. What is your impression of the instructors/facilitators of the program? Good? Well prepared?
    e. Do you have suggestions for improvements for any similar program in the future?

15. Regarding the initial impacts of the current enrichment programs:
    a. What would you suggest are the impacts on students that you have observed?
    b. What impacts did you see on teachers? What the impacts of the program on you?
    c. What about impacts on the parents?
    d. What makes a 'good' enrichment program?

16. How valuable are these STEM enrichment programs for your school in the future?

17. What future STEM enrichment programs would you see as highly effective?

Thank you for participating in this discussion. I appreciated your time and your opinions. It has been a pleasure talking with you.

Appendix 10: Questionnaires for Students' Parents

NOTE: *The below questionnaire provides an example that should adapted to suit the context of the audience. This adaptation should be done with careful consideration at the outset to maintain the same questionnaire across schools and through time so that trends can be evaluated. The selected questions should be piloted to assure that they are understood as intended.*

INTERVIEW QUESTIONS: Parents

About Parents

1. Please, tell us about yourself:
    a. What is your job?
    b. What was your previous job?
    c. Do you have any STEM qualifications? How useful were these qualifications to your current or previous jobs?
2. What do you think about science and maths in general and young people's interest in these subjects?
3. How do you think young people see STEM careers?

About the school and teachers

4. Do you think the school has adequate learning resources (teaching materials, laboratories, etc) to support a student's interest in STEM? Is there a particular area of STEM that is stronger than others? Which one, and why?
5. What are areas of STEM where you would like to see more or better teaching?

Your child

6. How do you think your children in school feel about:
    a. Science subjects – why?
    b. Technology subjects – why?
    c. Engineering subjects – why?
    d. Maths subjects – why?
7. How comfortable do you find your kids in her/his learning on:
    a. Science subjects – why?
    b. Technology subjects – why?
    c. Engineering subjects – why?
    d. Maths subjects – why?
8. What do you know about your child's plan for university or TAFE study and / or a career?
9. What influences your child to *choose* or *not to choose* STEM subject (e.g. science)?
10. Who/what has the most influence over your child's interest in his/her future career?

11. What are your child's interests outside school? Does your school/town cater to this interest? (Please tell us what and why)

12. Does your town cater to your child's future job ambitions (and your ambitions for them)? (Why? And why not?)

Initial Impact of STEM enrichment programs

13. Has your child been involved in the enrichment programs? Have you been involved?

    a. What was the event/program? What are your views about the strengths and weaknesses of the program?
    b. How did your child find about the event?
    c. What effect did the event/program have on your child? (e.g., learning, knowledge, skills)
    d. Do you think the event/program boosted your child's interest (and skills) in studying STEM subjects?
    e. What differences do you see in your child's STEM knowledge before and after the event/program?
    f. What differences do you see in their knowledge and perception about STEM careers before and after the event/program?

14. Given their level of interest - or disinterest - in the program, will you encourage your child to pursue further study in STEM subjects? Why?

15. Given their level of interest, will you encourage your child to have a STEM related career? Why?

16. If opportunities arise, what other enrichment programs would you suggest for children like yours?

Thank you for participating in this discussion. I appreciated your time and your opinions. It has been a pleasure talking with you.

Appendix 11: Observer form

	Comments / Observations *(see back for instructions)*
Do the **students** appear to be enthusiastic? Comments?	**Yes** ☐ **No** ☐
What is the turnout of **parents** (approx.)? Engaged well? N/A?	
How well does the event appear to be **organised** and run?	

Key criteria leading to successful outcomes of STEM educational programs

Key Criteria	**Year 5 – 6**	**Year 7 – 10**	**Year 11 – 12**	**To what extent do you see this happening?** *Very Visible (2) / Somewhat (1) / Not apparent (0) / Not applicable?*
1: Activity's overall aim is to 'stimulate interest'	✓			
2: Activities are enjoyable	✓	✓	✓	
3: Activity and Program seem tied to school curriculum and timed to its schedule	✓	✓	✓	
4: Activity and Program include informal learning and extra-curricular activities		✓	✓	
5: Activity and Program support students' confidence and self-belief in doing well in STEM subjects		✓	✓	
6: Activities are aimed to help students 'make connections' w/ professionals & topics outside school		✓		
7: Program features practical learning activities linked to daily life & local context		✓		
8: Activities aim to challenge and prepare students for higher education and training			✓	
9: Activities challenge students through interactive enquiry & problem solving			✓	

High points: What did you like best about the event that you are observing?	
Could be better: What could be improved? How?	
Effectiveness: In what ways does the event seem particularly effective?	
Success factors: What did you see as the key success factors in this event or activity?	
Other comments:	

Instructions:

This form is to enable someone observing an event or in-class activity to identify the ways in which it aligns with international 'best practices' in STEM enrichment programs. These criteria are from an evaluation framework assembled by the U of Queensland's Centre for Social Responsibility in Mining.

Your task is to observe the event or class and make notes in the boxes. Does the activity/class, for example, appear to "stimulate students' interest in science and mathematics" (criterion 1). That would be a target activity for younger students, in years 5 and 6. Is it 'very visible', 'somewhat visible', 'not apparent', 'not applicable'? What else do you want to note? Note it in the boxes on page 1 or page 2.

Your observations supplement more formal evaluation tasks carried out by each program provider, Qld Department of Education and Training, and UQ. Thank you!

Please return the completed form to ______________________________.