CSIRO

Australia's National Science Agency

Indigenous STEM Education Project

Aboriginal Summer School for Excellence in Technology and Science (ASSETS) Program

Evaluation case study outcomes report

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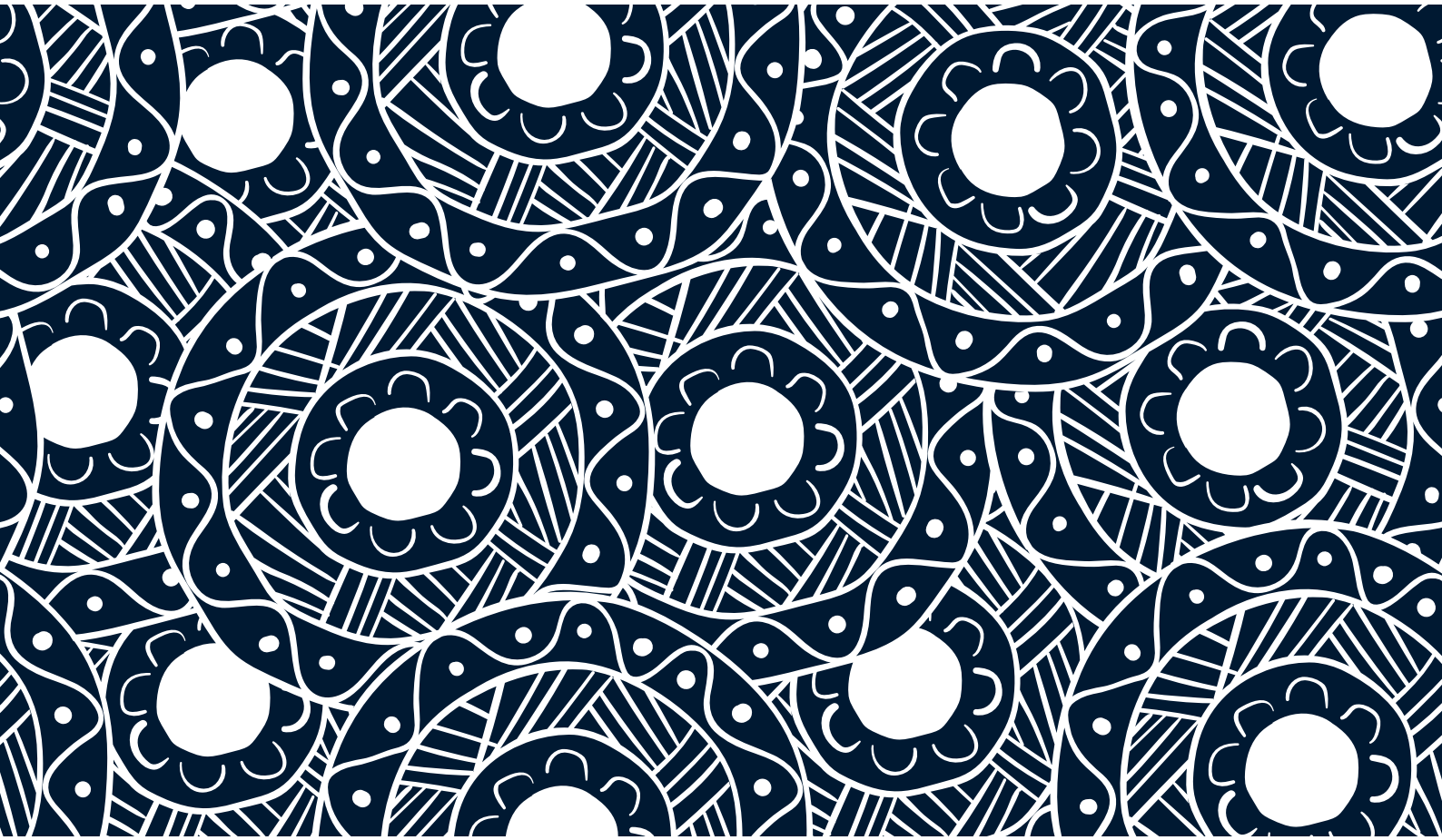

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Acknowledgements

Acknowledgement of Country

Aboriginal and Torres Strait Islander peoples have longstanding scientific-knowledge traditions. These traditions have developed knowledge about the world through:

- observation, using all the senses
- prediction and hypothesis
- testing (trial and error) and
- making generalisations within specific contexts

These scientific methods have been practised and transmitted from one generation to the next and contribute to ways of knowing the world that are unique as well as complementary to Western scientific knowledge.

A deep respect for these Aboriginal and Torres Strait Islander cultural practices and knowledge underpin the philosophy and practice of the Indigenous STEM Education Project. Recognition of traditional contexts for technologies and concepts and their application in the past, present, and future – including supporting modern STEM career pathways for Aboriginal and Torres Strait Islander students – reaffirm the ingenuity and creativity of Aboriginal and Torres Strait Islander peoples' knowledge systems.

The Indigenous STEM Education Project team acknowledges the Traditional Owners of the lands with whom this Project is collaborating and their vibrant living cultures and knowledge systems. In particular, we acknowledge the Traditional Owners of the lands on which the summer schools take place: the Kaurna, Ngarrindjeri, Awabakal, Worimi, Wulgurukaba, and Bindal peoples. We pay our respects to Elders past and present, and we thank all community members who are providing the leadership to ensure meaningful and effective engagement with Aboriginal and Torres Strait Islander communities for the six distinct, but complementary, STEM education programs that make up this Project.

CSIRO acknowledges that Aboriginal and Torres Strait Islander peoples make extraordinary contributions to Australia in cultural, economic and scientific domains; for example, incorporating Indigenous knowledge of ecological and social systems is vital to the achievement of sustainable development.

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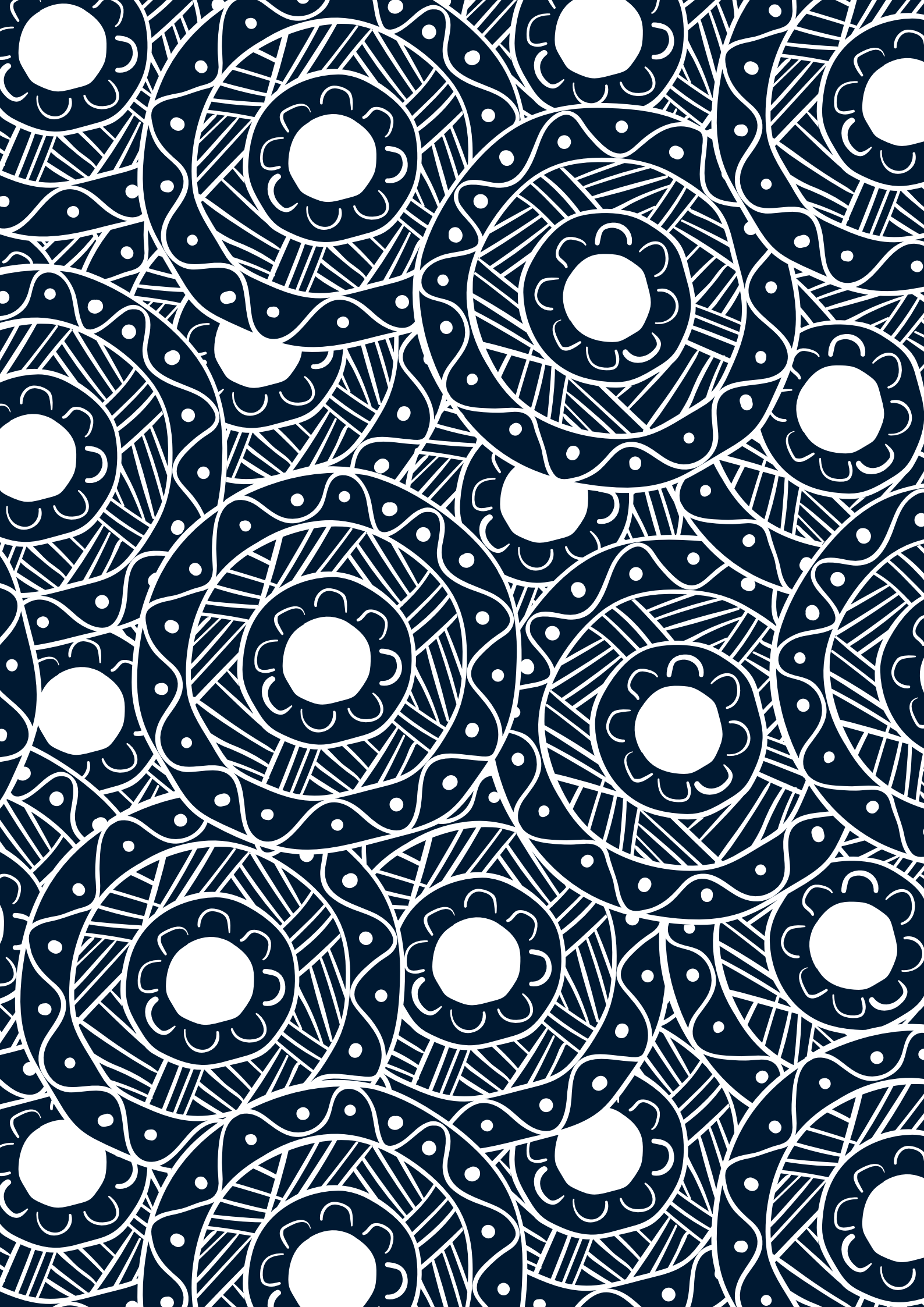

1 Introduction

This Evaluation Case Study Report outlines the degree to which the Aboriginal Summer School for Excellence in Technology and Science (ASSETS) program[1] has achieved its intended outcomes as per its Impact Pathway (Appendix A). The ASSETS program provides an opportunity for high achieving Year 10 Aboriginal and Torres Strait Islander students, with an interest in science, to explore the study and career options available to them in science, technology, engineering and mathematics (STEM) fields. ASSETS is one of six programs that comprise the Indigenous STEM Education Project, which is funded by the BHP Foundation and delivered by CSIRO. The overarching goal of the Indigenous STEM Education Project is to provide supported pathways that improve the participation and achievement of Aboriginal and Torres Strait Islander students in STEM subjects. The six programs cater to the diversity of Aboriginal and Torres Strait Islander students as they progress through primary, secondary, and tertiary education, and into employment.

Section 1 of this report outlines the case study methodology and rationale that has been applied to assess the ASSETS program. Section 2 comprises an outline of the key indicators used to assess the success of the program, as well as a brief overview of relevant research evidence. Section 3 of the report describes the key findings from the case study in relation to the program's evaluation framework and intended outcomes. The final section of the report includes a brief discussion around the findings of the case study, and concludes with recommendations for the program going forward. This case study considers the program's progress as of 30 June 2018.

1.1 Aboriginal Summer School for Excellence in Technology and Science (ASSETS) Program

1.1.1 History of ASSETS program

The ASSETS program was established by the University of South Australia in 1992 to promote academic excellence and learning opportunities for high achieving Aboriginal and Torres Strait Islander students in STEM. The program ran intermittently in Adelaide between 1992 and 2013 with a number of partners. Due to a lack of funding the program ceased to operate in the early 2000s, but was re-established in 2008 by the Australian Science and Mathematics School. In 2014, the ASSETS program was integrated into the Indigenous STEM Education Project (Tynan & Noon, 2017).

Several evaluations were conducted on previous iterations of ASSETS. For example, Clark and Merrotsy (2007) highlighted outcomes for students in the 2007 cohort, including affirmation of skills and talents, building of confidence and academic self-efficacy, and impact on career choice. The authors concluded that the holistic nature of the program was key to its success, as it incorporated academics, well-being, culture, sport and recreation, and identity. Aldous, Barnes, and Clark (2008) reviewed ASSETS in Adelaide in 2008 and identified several factors that assisted student engagement in science. These included the ongoing presence of Indigenous mentors, sessions related to culture, a leadership program involving Indigenous role models, and a place-based science unit. Finally, a review of ASSETS from 1992–2014 was completed in 2016, derived from a range of sources (Paige, Hattam, Rigney, Osborne, & Morrison, 2016). The findings of this review highlighted that students believed the cultural program was central to the success of ASSETS, including place-based projects making connections between science and Traditional Owners. Participants also reported increased self-confidence and satisfaction with their exposure to the university environment. The lack of post-program support to assist student's transition to STEM university pathways was noted.

1 Since its launch in 1992, the Aboriginal Summer School for Excellence in Technology and Science (ASSETS) has been inclusive of Aboriginal and Torres Strait Islander students, despite only including 'Aboriginal' in the program title. Program managers have considered changing the name of the program to explicitly include and recognise 'Torres Strait Islander' students, but this has not occurred for several reasons, including that ASSETS has built name recognition and a brand over a long period of time, and that the program is more widely known by its acronym.

1.1.2 ASSETS program components

ASSETS comprises three components: an intensive nine-day residential summer school (see Appendix B for a typical summer school timetable); a two-year leadership and support program; and an integrated and overarching cultural program. The primary component of the program is the nine-day summer school, which comprises three strands: culture and leadership; academic; and leadership and support.

The cultural and leadership stand is overseen by a Program Patron, who is a local leader in Indigenous education.[2] Also involved is a Senior Mentor – who is usually a member of the Indigenous support unit of the host university, and is present to facilitate a number of aspects of the program – and two Mentors[3] (one male and one female), who attend the entire summer school and provide ongoing support to students. The Program Patron and Mentors spend time with students and facilitate activities and workshops exploring cultural identity and Indigenous knowledges. Students are involved in cultural experiences such as fire pit nights and yarning circles, as well as learning about traditional art, music, and dance, and traditional medicines, foods and cooking. This strand allows students to reflect on their cultural identity, in addition to gaining a better understanding of the connection between Western science and Aboriginal and Torres Strait Islander science, culture, and knowledges.

The academic strand focuses on the science inquiry[4] process with students encouraged to be inquisitive and to investigate science concepts. Students at each summer school work with two academic providers from the local area. These could include groups from CSIRO, faculties from local universities, and other relevant organisations. Students spend a day with each academic provider allowing them the opportunity to explore a particular area of science with immersive activities and a chance to learn more about opportunities in that field. After working with the academic providers, participants work in teams to develop and conduct an open inquiry inspired by the academic activities. Program staff guide students through the scientific inquiry process and use materials developed for the Inquiry for Indigenous Science Students (I2S2) program to introduce these concepts. Students work together to develop an inquiry question and methodology before conducting their investigation and presenting their findings at the final presentation ceremony. Students are not assessed on their inquiry work or presentations.

The leadership and support strand focusses on leadership and personal development, while increasing awareness of STEM careers and pathways. Students participate in workshops focused on personal awareness and skills development, including exploring pathways into further study to help students plan for their senior schooling and beyond. Networking events with STEM professionals are also held to allow students to explore career options.

Upon successful completion of the summer school, the leadership and support program is offered to students through Years 11 and 12. This program aims to develop leadership skills and provide an opportunity for students to access tertiary education opportunities and work placements. Support may include advice and opportunities to participate in cadetships, and work placements and awards programs within the STEM fields. Students are also provided with the opportunity to stay in touch with the friends they made at the summer school by way of a secure online forum to share news and ideas. Program staff also use this forum to share information and opportunities with students. Students' leadership, communication and career skills are further developed through activities and guidance provided by the ASSETS team. All aspects of the ASSETS program are free for students.

2 The Program Patrons / STEM Student Ambassadors for recent Summer Schools were Professor Martin Nakata, Leah Armstrong, Professor Steve Larkin, Professor Peter Buckskin, and Eugene Warrior.

3 In Townsville, these positions are referred to as STEM Student Ambassadors. For simplicity, the positions from all summer school locations are referred to as Program Patron and Mentors in this report.

4 'Inquiry' is defined as a process by which students learn, particularly by actively inquiring through 'thinking and doing' related to a phenomenon or problem.

1.1.3 Comparison with other STEM enrichment programs

There are a number of opportunities for Aboriginal and Torres Strait Islander high school students to become involved in STEM-related residential summer schools/ camps and pre-university STEM programs across Australia (referred to as 'STEM enrichment programs' hereafter). Appendix C presents a brief summary of fifteen current and recent STEM enrichment programs based on publicly available information.[5] ASSETS shares similar features with many of these programs, including:

- No, or nominal, costs to participants – most STEM enrichment programs include free flights, accommodation, and food for participants.
- Focus – most programs focus on inspiring interest in STEM study and careers and orienting participants to university life.
- Activities – hands-on or on-country activities and site visits to science facilities are common features of most programs.
- Program partners – the involvement of Aboriginal or Torres Strait Islander mentors, current university students, and STEM professionals is also common.

However, there are several key differences between ASSETS and many of the other programs, including ASSETS' program duration; its explicit focus on cultural identity; the inquiry approach to learning; and the continuing leadership and support component. Several other STEM enrichment programs include these features individually, but none appear to contain them all. The summary of distinguishing features below includes some relevant information from the case study findings, which are included for contextual purposes.

Duration

Of the programs summarised, ASSETS is the longest STEM enrichment program (nine days); although two other programs are eight days in length, with the average being five to six days. According to one program staff member, some ASSETS participants shared that they thought other, similar programs seemed 'too rushed'. Program staff commented that ASSETS presents a valuable opportunity to introduce students, over a reasonable period, to the practical benefits of science. Students are given the entire day to complete their inquiry experiments, which according to staff, enables students to gain an effective grasp of all the learning components. Staff felt that this is far better than pushing students to complete tasks over a shorter time frame. Students agreed with staff about the duration of the summer schools. The participant post-survey (n = 67) for the 2017-18 summer schools indicated that students agreed with staff about the duration of summer schools, where 57 per cent of respondents thought the length of the summer school was 'just right' while 36 per cent felt it was 'too short'; and less than 8 per cent of respondents felt it was 'too long'. One student commented that they would have liked to extend the length of ASSETS even further: "...I feel you could really do so much more if we stayed longer and travelled a bit more". Another student thought ASSETS "...would be better if it was over a longer period" to ensure sufficient time to rest and take in the experience.

Another beneficial factor of ASSETS is the intensity of the curriculum and activities. Even though the summer school strand is relatively long, it is structured to concentrate on only a few key aspects, thus giving students more opportunities to thoroughly understand concepts and enjoy the learning experience. According to academic providers, the program includes only learning items that have a clear purpose and it is not crowded by other, less relevant, learning items.

Cultural identity and Indigenous scientific knowledge

ASSETS has an explicit focus on exploring cultural identity and Indigenous scientific knowledges. In addition, ASSETS' core approach utilises two-way learning in science, which involves integrating Indigenous scientific knowledges with the Western curriculum. Although some other STEM enrichment programs incorporate Indigenous scientific knowledges into the science curriculum[6], few others concentrate on building confidence in cultural identity as a stand-alone activity and goal.

5 No assumptions have been made where information was not readily available publicly.

6 For example, The University of Wollongong's Koori STEM Camps also have an explicit focus on providing an Aboriginal and Torres Strait Islander traditional knowledge context in conjunction with science topics.

Inquiry focus

ASSETS focuses on the science inquiry process, with students encouraged to be inquisitive and to investigate scientific concepts. Students work in teams to develop and conduct an open inquiry. One program staff member said that the program "ignite[s] imagination" and gives students "control to explore and [test] for themselves". In other words, the program has a significant student-led inquiry component. Hands-on, active, and inquiry-based learning are evidence-based approaches that have been shown to create effective learning environments that increase conceptual understanding (Goss & Sonnemann, 2017; Hmelo-Silver, Duncan, & Chinn, 2007; Minner, Levy, & Century, 2010). Inquiry skills, in particular, have been recognised as both embedded in Aboriginal and Torres Strait Islander cultures (Queensland Curriculum and Assessment Authority, 2019). Inquiry skills (such as critical thinking) are also of essential importance to STEM literacy and careers (Lederman, Lederman, & Antink, 2013; Office of the Chief Scientist, 2014). Inquiry-based learning builds from a natural process of inquiry in which students experience the curiosity to know certain things, which motivates and deepens learning (Rosicka, 2016). Only one other STEM enrichment program explicitly promotes scientific inquiry as a program feature (i.e., Indigenous Science and Engineering Program in New South Wales).

Enduring support

ASSETS includes a leadership and support program that continues assisting participants through Years 11 and 12, and includes a work placement option. This ongoing contact with, and assistance for, alumni seems to be relatively distinct from similar programs. Program staff and STEM professionals regarded the ASSETS program as "much needed orientation to the real world after school". They considered the program to be particularly important at a time when the career options for students were so varied; and that, in general, many high school students did not give due consideration to career options beyond school. The ASSETS program, according to a STEM professional, gave students a "glimpse into what's out there"; and the leadership program supported students as they made the transition to university and career paths. ASSETS also offers another avenue of support for families and teachers by providing advice and guidance, particularly around student motivation and future opportunities.

1.1.4 ASSETS recruitment of summer school participants

The recruitment process for the ASSETS program occurs once a year. As part of this process, the ASSETS program team and CSIRO Corporate Affairs deliver a campaign and disseminates information about the summer school through schools across Australia, the program's existing networks, print media, and for the first time in 2018, through social media.[7] Students are required to submit an application to the ASSETS team that includes questions for both the students and a nominated teacher to complete. Students are required to explain why they would like to attend; what excites them about STEM; what they would contribute to the program; and what STEM activities they are currently involved in. Alongside the application the student must provide the ASSETS team with their most recent report card.

Teachers are required to explain what they believe the student would contribute to the program; and to complete an assessment of the student's competence (i.e., engagement with STEM, working in new surroundings, working in teams, persistence with challenging tasks, etc.). Each year (except for the first year), 105 students are selected to participate in ASSETS.

All applications are assessed by a panel of STEM and education professionals; students are shortlisted; the shortlist is then cross-checked by multiple team members; and then the summer school attendees are finalised. Students are then allocated to a summer school based on their preferences and are given the option of their first preference where possible.

1.1.5 Program locations and attendance

In 2014, a summer school was held in Adelaide, as a transition to the new program. In the successive years thereafter, three summer schools were held in Townsville, Newcastle and Adelaide with 105 positions available each year. In 2017, a total of 175 applications were received, surpassing the 119 applications received in 2016 (Ma Rhea et al., 2018) (see Table 1 for a summary of locations and attendance numbers). Student intake involves potential participants being offered positions in the program. However, for a variety of reasons some do not attend, owing to, for example, sickness, nervousness, or family/extra-curricular commitments. Over the initial years, program staff have developed systems to support students and families to minimise dropout rates and to find replacement participants in a timely manner.

7 For the applicants (n = 147) in the 2017 and 2018 Summer Schools who responded to the pre-survey (prior to the introduction of the social media campaign), the most common sources for finding out about ASSETS were: school teachers/counsellors (67 per cent), Indigenous education workers (30 per cent), family members (19 per cent), friends (8 per cent), school principals (5 per cent), school notice boards/newsletters (3 per cent), community Indigenous organisations (1 per cent), and the Internet (1 per cent).

1.2 Scope and purpose of evaluation

The purpose of this report is to present the key findings of a case study applied to the ASSETS program that has informed a key evaluation question: How has the ASSETS program facilitated the Project's overall goal to improve the participation and achievements of Aboriginal and Torres Strait Islander secondary students in STEM?

An Impact Pathway (Appendix A) was developed for ASSETS outlining the inputs of the program, the intended activities of the program, program outputs, and expected outcomes and impacts. This case study seeks to provide evidence for six[8] of the ten outcome areas outlined in the Impact Pathway as follows:

- High aspirations for a STEM career (including Subject choices that reference prerequisites for university STEM courses)
- A better understanding of and confidence in pursuing STEM career pathways
- Greater confidence in cultural identity and the relevance of culture for STEM careers
- Growth in student and professional networks
- Increased community and parental engagement

The remaining four outcomes will be examined in the forthcoming Indigenous STEM Education Project Evaluation Reports[9]:

- Schools, jurisdictions, and stakeholders valuing the summer school and leadership program
- Greater demand for ASSETS from schools/ jurisdictions; identification of future funding partners
- Success in STEM subjects in Years 11–12, particularly direct university entry from high ATAR
- Participation in broader STEM initiatives, for example work placements, Indigenous STEM Awards Program, Creativity in Research, Engineering, Science and Technology (CREST) Awards, university STEM programs

Table 1. Summer school locations, applications and attendance (2014 to 2018)

YEAR	LOCATIONS	NUMBER OF APPLICANTS	NUMBER OF PARTICIPANTS	PROPORTION OF APPLICANTS ACCEPTED (PER CENT)
2014	Adelaide	30	28	93
2015–2016	Townsville, Newcastle, Adelaide	119	98	82
2016–2017	Townsville, Newcastle, Adelaide	175	101	58
2017–2018	Townsville, Newcastle, Adelaide	118	104	88

8 'Subject choice referencing prerequisites for university STEM courses (e.g., Maths B is a prerequisite)' has been categorised as a subset of 'High aspiration for a STEM career' because it is a specific education goal along the pathway to a STEM career.

9 The original case study methodology did not allow for the robust assessment of some outcomes due to the longer-term horizon of the intended impacts, and some methodological challenges, such as keeping in contact with ASSETS alumni.

1.3 Methodology

ASSETS has an established program monitoring strategy and assessment measures to understand the level of success the program has achieved against the intended outcomes. A case study methodology was employed as it allows for participants and researchers to explore concepts in greater detail, as well as the ability to be a strong conduit for the voices of program participants (Harrison, Birks, Franklin, & Mills, 2017). This case-study primarily involved collecting data through a series of interviews with students, program staff, and program partners (academic staff from other agencies and programs who volunteer their time and expertise, and STEM professionals). To supplement these data and provide a more complete picture of the progress towards the intended outcomes, the data from surveys administered as part of the program monitoring process have also been referred to throughout the findings.

1.3.1 Interviews

A series of interviews were undertaken with students, program staff and program partners who attended the 2017 summer school held in January in Newcastle. One location was selected for the case study interviews to allow for an in-depth examination. In addition, although each summer school location offers different activities and experiences, the research questions were aimed at broader issues related to, for example, networks, culture and aspirations, that were not dependent on specific activities. Interview questions were semi-structured and were used to guide the conversation with participants (See Appendix D). Interviews were deemed the most appropriate methodology because they allow an in-depth exploration of complex concepts, such as cultural identity, and for the personal views and experiences of participants to be understood.

Interview participants were asked about their experiences while attending the ASSETS summer school and for any recommendations to improve their experience, specifically in terms of what may have made the summer school more engaging and impactful for them. Further, students were asked what parts of the curriculum they enjoyed (and engaged with) the most; and what were their future aspirations. There were 19 individual interviews and nine group interviews (each with two participants), resulting in a total of 37 participants (see Table 2).

A qualitative thematic analysis was undertaken to synthesise the interview transcripts. The thematic analysis involved three stages of coding, the first resulting in a basic set of distinctive themes, followed by more interpretative codes that represented an understanding of the participants' experiences (Willig & Rogers, 2017). The interview data were then divided into high-level categories (themes) comprising: Engagement; STEM Career; Career Pathways and University; Culture; Professional and Social Networking; Community and Parent Engagement; and Recommendations for the Program. Themes were further separated into sub-themes and given a descriptive name reflecting the concept or observation made during the interviews. Each sub-theme was reviewed and placed under the appropriate high-level themes. The remaining codes were analysed and placed within a hierarchical order based on their frequency within the interviews. All participants gave their informed consent to be a part of the study, and to have their interview recorded. Recordings were transcribed and de-identified before analysis commenced. Illustrative quotes are included in this report and have been de-identified to protect the confidentiality of the participants.[10]

Table 2. Interview participants and total program participants, by stakeholder group

GROUP	NUMBER PARTICIPATING	TOTAL NUMBER IDENTIFIED AND INVITED TO TAKE PART	PER CENT PARTICIPATING (%)
Students	18	33	55
ASSETS program staff	11	11	100
Program partners and STEM professionals	8	22	36
Total	37	66	56

10 For example, by using singular 'they' or 'their' in place of gender-specific pronouns, and by removing references to specific geographic places.

1.3.2 Online surveys

A suite of online surveys are currently employed as part of the monitoring of the program (see Table 3), including pre- and post-summer school participant surveys (for students to complete before and after attending the summer school), surveys of parents/care-givers of participants (for parents/carers to complete after their child has attended the summer school), and destination surveys for former participants (for students after completing the summer school in Years 11 and 12, and post-high school). The pre- and post- surveys pose a series of questions about students' aspirations and their viewpoints on the strengths, weaknesses, and outcomes of the ASSETS program. The parent survey asks respondents about the perceived impacts of the program on their children, including levels of engagement both before and after attending the summer school, the perceived personal development (i.e., cultural identity, confidence, and networking), and the students' career aspirations after attending the summer school. The destination survey asks students about the impact of the program on their subject choices, career pathways, and their personal development, specifically the impact on their cultural identity. All surveys include both quantitative and qualitative response types. The Indigenous STEM Education Project First Evaluation Report (Tynan & Noon, 2017) and Second Evaluation Report (Ma Rhea et al., 2018) provided a high-level analysis of the survey responses. Appendix E contains a summary of all quantitative online survey data available to date.

For each survey, a landing page was provided for the participants to grant consent before proceeding to the survey questions. Each participant gave their consent to be a part of the study alongside their permission for any data (for example, grades and changes in subjects) to be utilised for evaluating the program. All quotes from the surveys provided in this report have been de-identified to protect the confidentiality of the participants.

Table 3. Survey respondents by survey type and summer school cohort years

SURVEY TYPE	COHORT YEAR: YEAR ATTENDED ASSETS			
	2014–15	2015–16	2016–17	2017–18
Pre (participants)	n/a	n/a	72	75
Post (participants)	n/a	n/a	79	67
Parent	n/a	n/a	49	49
Year 11	n/a	n/a	31	55*
Year 12	n/a	n/a	24*	n/a**
Destination	8	30***	n/a**	n/a**
Total	8	30	255	246

Notes: Ethical approval to conduct program monitoring and evaluation activities was granted in 2016 and therefore surveys were not conducted prior to this date. *The Year 11 survey for the 2017–18 cohort and Year 12 survey for the 2016–17 cohort were distributed in November 2018; the quantitative results are included in this report, but the qualitative results will only be available in future reports as there was not enough time to conduct analyses before publication. **These surveys had not been distributed at the time of compiling this report. ***Destination surveys were sent to all former participants involved in the program at least two years prior; for example, the 30 responses from the destination survey distributed in 2018 include respondents from the 2014–15 and 2015–16 cohorts.

1.3.3 Limitations of the evaluation

The evaluation methodology has several strengths but also several limitations that ought to be noted. First, interviews with participants and staff were conducted for one summer school (Newcastle) for one cohort year (2017–18) only. The findings from these interviews have been applied to the program; however, there were likely some differences among the summer school locations and cohorts. Offsetting this limitation is the considerable amount of survey data that has been collected across all locations and multiple cohorts through other program monitoring processes. Second, the program monitoring has encountered the common issue in longitudinal social research of difficulty maintaining contact with former participants, resulting in declining response rates for the Years 11 and 12, and destination surveys. To counteract this, a nominal incentive for taking time to complete the survey ($25 cash voucher) has been introduced in 2018, with the secondary goal of boosting response rates. The compensation was a token amount and was not deemed large enough to induce participation beyond peoples' better judgement; to skew the results; or to make it difficult to withdraw from the survey process.

The case study focused on six of the ten program outcomes, and therefore provides a robust but partial picture of the impact of the program. Future data collection and analyses will provide a more complete understanding. Finally, data collection methods have primarily been based on participant self-reports through interviews and surveys. Self-report measures are susceptible to several threats to validity, including response biases and lack of introspective abilities. To lessen these threats, the overall evaluation methodology relied on data from multiple viewpoints (participants, program staff, parents, and STEM professionals) and from participants over multiple points in time over several years. In addition, one non-self-report measure was used to assess educational outcomes, that of school grade data.

2 Definitions and indicators

This section provides a brief outline of the definitions and indicators used to assess the intended outcomes of ASSETS. A brief overview of relevant research literature in each outcome area is also included in Appendix F to provide context for the findings.

2.1 High aspiration for a STEM career (and STEM subject selection)

Culturally competent education provides educational experiences for young people that reflect, validate, and promote their culture, and, importantly, are cognisant of students' future aspirations (Lewthwaite, Osborne, Lloyd, Boon, & Llewellyn, 2015). A career aspiration is a planned pathway to an occupation (usually comprising a series of goals), which is unadjusted for any perceived constraints (Sikora, 2018). In contrast, career expectations are more realistic plans that consider what is possible to achieve. These tend to be better predictors of attainment than aspirations (Sikora & Biddle, 2015). Educational and career aspirations are distinct yet related types of ambitions (Sikora & Biddle, 2015). A 'STEM career' is defined as undertaking an occupation for a significant period of a one's life in a STEM field, comprising the natural and physical sciences, information technology, engineering, or mathematics (Office of the Chief Scientist, 2016a).

The indicators of a 'high aspiration for a STEM career' provide evidence of students' motivation, plans, and pathways that comprise:

- Education goals, such as undertaking university pre-requisite subjects in high school; achieving high grades in STEM subjects; undertaking non-school STEM activities or learning opportunities; completing high school; entering university/TAFE; and completing a university degree or other qualification.
- Employment goals, such as seeking information and advice about STEM careers; undertaking training for specific STEM careers and occupations; wanting to contribute to or impact in a STEM field; and wanting to use a STEM career to contribute to their community or society.

A separate outcome, 'Subject choice referencing prerequisites for university STEM courses (e.g., Maths B is a prerequisite)' has been categorised as a subset of 'High aspiration for a STEM career' because it is a specific education goal along the pathway to a STEM career.

2.2 Better understanding of, and confidence in pursuing, STEM career pathways

A 'STEM career pathway' is the series of goals and tangible steps required to successfully enter and maintain an occupation in a STEM field. 'Understanding' is defined as having the knowledge and comprehension of the steps required to attain the desired STEM career. 'Confidence' is defined as a student's belief in their ability (self-efficacy) to identify resources and overcome obstacles in achieving their career ambitions (Reddan, 2015).

Indicators of understanding STEM career pathways are clear knowledge of the pathways and steps involved in entering and progressing in a STEM occupation, including existing STEM career options; occupations and skills that will be in demand in future; qualifications and skills required to enter and progress in a STEM occupation; and the costs (and financial supports available) involved in obtaining relevant degrees and qualifications.

Indicators of confidence pursuing STEM career pathways include a belief that one can: overcome adversity and solve problems along a career pathway; marshal the resources needed to attain goals; undertake career-related behaviours and actions; and achieve career goals (Praskova, Creed, & Hood, 2013).

2.3 Greater confidence in cultural identity and the relevance of culture for a STEM career

'Cultural identity', in the context of this outcome, is the identification with, and sense of belonging to, Aboriginal or Torres Strait Islander peoples and culture. Cultural identity is formed or increased where belief systems, values, obligations and practices are shared and reinforced. Cultural identity closely aligns with the concept of self-identity (Dockery, 2013); and the ways in which it is experienced vary greatly among individuals (McRae et al., 2000). Some researchers believe that the concept of cultural identity cannot be measured objectively, and that only through subjective exploration can the concept be properly understood (Manning, Ambrey, & Fleming, 2016). The construction of a 'pan-Indigenous identity' can be limiting, as it fails to acknowledge the diversity of experiences and practices among Aboriginal and Torres Strait Islander peoples (Bodkin-Andrews & Carlson, 2016; Yamanouchi, 2010).

A 'greater confidence in cultural identity' is indicated by students being more assured and certain of their identification with Aboriginal or Torres Strait Islander heritage and traditions and belonging to a culture. For example, confidence could be exhibited through plans to participate in cultural activities, connecting with other Aboriginal and Torres Strait Islander families[11] or cultural knowledge holders, and learning more about their culture.

The 'relevance of culture for a STEM career' has two related aspects: (a) students' awareness of the contributions that Aboriginal and Torres Strait Islander peoples have and continue to make in STEM; and (b) the knowledge that a strong cultural identity is a source of strength and resilience while navigating a pathway to, and progression in, a STEM career.

Indicators of understanding the 'relevance of culture for a STEM career' are: citing examples of Aboriginal and Torres Strait Islander scientific knowledge and methods; identifying Aboriginal and Torres Strait Islander people (role models) who have made contributions to scientific knowledge; and recognising cultural identity as a source of strength and resilience in a STEM career.

2.4 Growth in student and professional networks

A 'student network' is defined as a connected group of student peers originating from within the ASSETS program, but which may extend beyond ASSETS alumni as more connections are made. Connections can be made in person, or through social media and mobile applications, to interact with each other and discuss issues of common interest or of concern (such as STEM or shared learning and educational, and career aspirations). The members of a student network may also be 'friends' that provide social or emotional support, although this is not essential to forming a network. An indicator of a 'growth in student networks' is students having a greater number of connections with peers than before participation in ASSETS, particularly connections with Aboriginal or Torres Strait Islander peers with a shared interest in STEM.

A 'professional network' is defined as a connected group of professionals (such as STEM professionals, university staff, and career counsellors) that provide education and career-related advice, guidance, information and opportunities to students. An indicator of a 'growth in professional networks' is students having a greater number of connections with professionals than before participation in ASSETS, particularly those that can support their STEM aspirations.

11 Family (in the context of this report) refers to the parents, caregivers, families and extended families, Elders and community members involved in the education of Aboriginal and Torres Strait Islander children.

2.5 Increased community and parental engagement

Parents and other adults within a community have an important role to play in engaging with young people to support and influence their academic and career pathways (Gavidia-Payne, Denny, Davis, Francis, & Jackson, 2014; Pendergast, Allen, McGregor, & Ronksley-Pavia, 2018). Broadly, 'engagement' can be defined as the time, energy and resources devoted to activities, with the intention of achieving an educational goal or outcome (Pittaway, 2012).

In recognition of Aboriginal and Torres Strait Islander family and kinship structures, 'parents' are defined as students' primary caregivers, which may include extended family, family clan members, and non-biological adults who look after or raise students (Bobongie, 2017; Lohoar, Butera, & Kennedy, 2014). Parental engagement refers to a range of parental practices, both at home and in educational settings, intended to promote children's academic achievement (Chenhall, Holmes, Lea, Senior, & Wegner, 2011). Indicators of parental engagement include encouragement of learning at home and in extracurricular activities; communication with teachers and ASSETS program staff; cooperation with educational organisations; and volunteering time and resources in educational activities.

The term 'community' may refer to a place or group of people with something in common. Applying a youth-centred and context-specific lens to the term 'community' allows the definition to be specific to each young person, and includes a range of possible stakeholders that enable their educational success (Flouris, Crane, & Lindeman, 2016). For the ASSETS program, 'community' can include Aboriginal and/or Torres Strait Islander and non-Indigenous supervisors, mentors and leaders; peers; the broader education community; workplaces; cultural leaders, such as Elders and Traditional Owners; and youth and community-based services. 'Community engagement' describes a model of authentic collaboration and purposeful interaction between institutions and the communities in which they operate (Lowe, 2017). Positive community engagement within the ASSETS program may be indicated by the close involvement of a range of program partners with the intention of developing partnerships among students, families, schools and students' home communities to support students in their education and employment goals.

3 Findings

The findings of the case study have been organised into key themes under the six outcomes under examination (NB: the first section combines two outcomes) and reflect the responses of current and former participants, program staff, volunteers, STEM professionals, and parents/caregivers.

3.1 High aspirations for STEM careers (including STEM subject selection)

3.1.1 Factors supporting aspirations

Before considering the key indicators of this outcome, it is worthwhile noting some of the key factors that program participants and staff suggested affect aspirations, but are outside the scope of ASSETS. Program staff considered high aspirations to be critical to students' success in the program. One member of staff emphasised that, not only was it important in the ASSETS program, it was important that students came into the program having been supported to have high aspirations in school. Families, too, play a crucial role in establishing a mentality of high aspirations, and this includes extended family as one member of the program staff found in extensive consultation with a student's grandparents. One member of the program staff commented that students, "need to know that their families are behind them and there is that support and encouragement". The member of staff went further by qualifying what type of support is required by families to develop high aspirations in students by stating that, "[i]t doesn't have to be financial support [but] just encouragement that 'you can do this, or this is something that's very important'". In other words, according to a member of the program staff, families needed to be fully 'on board' and come along on the student's journey.

Program staff were keen to differentiate between establishing aspirations and supporting aspirations. Some staff felt that the ASSETS program was not designed to establish aspirations or attempt to motivate students towards their aspirations, but rather it supported students' passion for science by getting them to like learning. They justified this position by stating that the end goal of the program was not for students to be assessed through an examination. Rather, the focus was on showing students that learning could be fun. Students therefore, according to staff, were not going to be pushed into achieving. They needed to have high aspirations before they came into the program; and the goal of the program was to support these already established high aspirations.

3.1.2 Educational aspirations, including subject selection

Some students described how ASSETS helped build their educational aspirations. One student sought assistance from program staff on how to "...apply myself better to get the good grades that I need to get into universities". Other students noted how the structure of ASSETS, compared to a school classroom, built their excitement to attend university: "I probably prefer this kind of environment than a school and that's really why I'm looking forward to university". Another student said that ASSETS was an opportunity to build on their existing aspirations, "I had the aspiration for science. I decided I wanted to come to this camp because science is my favourite subject at school... so I thought if I enjoy it I might as well go do a camp that involves it". Finally, one ASSETS alumni thought ASSETS had "helped me achieve my goal of getting into university".

ASSETS participants showed an increase in awareness of university pre-requisites (2017 and 2018 summer schools). As can be seen in Table 4, there were increases in the proportion of students understanding what a prerequisite subject was (up 19.7 and 35.7 per cent) and knowledge of what the pre-requisite subjects were for what they wanted to study at university (up 36.4 and 36.8 per cent). A paired samples t-test was conducted to compare the 2017 and 2018 ratings for these questions, and a significant difference ($p < .001$) between the means was found for both years (see Table 4).

This increased awareness aligns with the program intent of students meeting qualified scientists and gaining a realistic idea of what a career in science might involve. The students also received intensive exposure to working in groups – another essential requirement for scientific work.[12] The data in Table 4 suggest that many students became more knowledgeable in terms of their understanding of meeting the requirements for university entrance and demonstrates their developing maturity, with them taking ownership of their journey along the pathway to a university degree and career.

For some students, ASSETS confirmed they were on the right track in terms of STEM subjects. A student noted, "The ASSETS camp...helped me feel more secure about the STEM subjects I have already picked for Years 11 and 12". Significantly, as a result of their increased awareness, other students made changes to their school subject choices to better align themselves with successful university entrance and preparation for a career in science. One student said, "As a result of attending ASSETS, I have found a new career I am interested in doing. Therefore, I have changed my subjects to have the pre-requisites to get into that field".

Another student felt the program enabled them to be more focused on the necessary pre-requisite subjects required to acquire entry into a chosen course, while another student was not even aware of certain career options before the ASSETS experience, as evident in this response, "This program has given me insight into a career I never knew existed. It influenced me to change my subjects to best suit that career so I have the pre-requisites to get in".

Table 5 shows the self-reported grades in STEM subjects of ASSETS alumni based on results from the ASSETS Year 11 survey (from 2017). The data indicates that almost all students (98 per cent) scored in the highest three assessment bands in Science, Very High Achievement (VHA), High Achievement (HA) and Sound Achievement (SA). In Maths, the figure was 94 per cent, and in Technology and Engineering the figure was 75 per cent. This would indicate that, academically, students were well placed to be competitive for places of choice at a university. Although the grades were self-reported, they broadly aligned with the distribution of grades from official transcripts provided by participants when they applied for ASSETS; therefore, there is a high degree of confidence in the validity of the self-reported data.

Table 4. Students' increase in awareness of pre-requisites during the ASSETS program

MEASURE	PRE SUMMER SCHOOL	POST SUMMER SCHOOL	DIFFERENCE
I KNOW WHAT A PREREQUISITE SUBJECT IS			
2017 Percent strongly agree or agree (n = 66)	72.7%	92.4%	+19.7%
2017 Mean (n = 66)	3.97	4.53	t = -5.18 p < .001
2018 Percent strongly agree or agree (n = 56)	57.1%	92.9%	+35.7%
2018 Mean (n = 56)	3.54	4.54	t = -6.45 p < .001
I KNOW WHAT THE PRE-REQUISITE SUBJECTS ARE FOR WHAT I WANT TO STUDY AT UNIVERSITY			
2017 Percent strongly agree or agree (n = 66)	50.0%	86.4%	+36.4%
2017 Mean (n = 66)	3.64	4.24	t = -4.75 p < .001
2018 Percent strongly agree or agree (n = 57)	47.4%	84.2%	+36.8%
2018 Mean (n = 57)	3.42	4.26	t = -6.06 p < .001

12 The Office of the Chief Scientist (2015) report that over 80 per cent of surveyed Australian employers (n = 1,065) consider 'interpersonal skills' as very important or important among STEM qualified employees, which was the fifth-highest among the thirteen skills rated. The Western Australia Department of Education (2019) lists teamwork and communication as key STEM skills. In addition, the American Association for the Advancement of Science considers facilitating effective teamwork, and handling conflicts, as key skills for scientists (Hobin, Fuhrmann, Lindstaedt, & Clifford, 2012).

In addition, an analysis was undertaken to compare Year 11 and Year 12 alumni grades (after attendance at ASSETS) with their Year 10 grades (before attendance at ASSETS).[13] The sample of students who responded and made available their grades for both Year 10 and Years 11/12, was relatively small (n = 11 students for Year 12 and n = 14 students for Year 11, for a total of n = 25 students). Grades were transformed into a consistent scale of 1 (E) to 5 (A) and means and frequency distributions were tabulated. Table 6 shows the results across all STEM subjects. For the Year 12 students, the average grades in STEM subjects increased (from an average of 3.88 to 3.97) and the number of 'A' and 'B' grades increased from 60 per cent to 66 per cent. For the 11 students with data, six students' average grades increased, one remained the same, and four decreased. However, the results for Year 11 students demonstrated the opposite trend. The average grade decreased from 4.06 to 3.75, and the proportion of 'A' and 'B' grades decreased from 81 per cent to 65 per cent. For the 14 students with data, three students' average grades increased, three remained the same, and eight decreased. The variability in results between Year 11 and Year 12 is possibly related to the small sample size, which affected the reliability of the results; an increasing difficulty of subjects in Year 12; and differences between the two cohorts.

Students' high academic results align with the target cohort of the program of high achieving students, and reaffirms the information presented earlier by program staff and STEM professionals that the ASSETS program is not solely about students progressing academically or assessment of gained knowledge. Rather, the program is equally concerned with students making valuable contact with professionals and learning to work in teams.

Two destination surveys conducted in June 2017 (n = 8) and April 2018 (n = 30) followed up with former participants of the 2014-15 and 2015-16 summer schools. Responses from the latter survey indicated that 97 per cent of respondents had completed Year 12, and that 67 per cent were currently attending university (of the other students, seven per cent were attending TAFE, 23 per cent were employed, and three per cent were on a gap year). Although ASSETS is primarily aimed at high achieving students, it is encouraging to note that former participants were far exceeding national statistics on high school retention and university attendance. For example, in 2016, 65.3 per cent of 20 to 24-year-old Aboriginal and Torres Strait Islander people had Year 12 or equivalent attainment, while 1.7 per cent of the domestic student university population comprised Aboriginal and Torres

Table 5. Students' achievement in STEM subjects in Year 11 (per cent)

SUBJECT	A (OR VHA / EA)	B (OR HA / HA)	C (OR SA / CA)	D (OR LA / SA)	E (OR VLA / PA)	TOTAL
Science	38	31	29	2	0	100
Maths	15	46	33	6	0	100
Technology and Engineering	50	0	25	25	0	100

Note: VHA = Very High Achievement; HA = High Achievement; SA = Sound Achievement; LA = Limited Achievement; VLA = Very Limited Achievement; EA = Exceptional Achievement; HA = High Achievement; CA = Commendable Achievement; SA = Satisfactory Achievement; PA = Preliminary Achievement. n = 31.

Table 6. Students' achievement (per cent) in STEM subjects in Year 10/ 11 and Year 11 / 12

	2016–17 COHORT (N = 11 STUDENTS)		2017–18 COHORT (N = 14 STUDENTS)	
	YEAR 10 (N = 25 GRADES)	YEAR 12 (N = 33 GRADES)	YEAR 10 (N = 31 GRADES)	YEAR 11 (N = 32 GRADES)
Mean grade	3.88	3.97	4.06	3.75
Frequency distribution (per cent)	A – 36 B – 24 C – 32 D – 8 E – 0	A – 30 B – 36 C – 33 D – 0 E – 0	A – 26 B – 5 C – 19 D – 0 E – 0	A – 9 B – 56 C – 34 D – 0 E – 0

Note: For mean grades: A = 5, B = 4, C = 3, D = 2, E = 1.

13 The Year 11 survey respondents attended ASSETS in 2017-18, and the Year 12 survey respondents attended ASSETS in 2016-17.

Strait Islander peoples (Department of the Prime Minister and Cabinet, 2018). As yet, it is too early for ASSETS alumni to have completed a university degree or qualification, but future reports will assess university completions among alumni. Overall, it is a positive result that a high proportion of participants have gone on to attend university or TAFE.

There were also some indications that participating in ASSETS led students to become involved in other STEM activities and opportunities, through their increased confidence or knowledge. One student said that ASSETS "...inspired me to...go on and apply to attend [an overseas science camp] and get further involved in both academic and cultural pursuits". Other students were inspired to give back to their communities, "As a result of ASSETS...I am more focused on how I can use my talents or future career paths to benefit and help my community and my people".

3.1.3 Career aspirations

There was limited evidence that ASSETS directly contributed to building career aspirations of students. Participants most frequently described their career aspirations without reference to ASSETS. Several students described detailed plans for their career aspirations – for example attending TAFE, completing bridging courses, and then obtaining a university degree to enter their chosen profession. One student said "I have always been interested in [subject], and would be interested in studying to become a [profession]", suggesting that their career aspirations were already firmly in place before ASSETS. However, some students did say that ASSETS had "changed the way I worked at school, it made me work harder to reach my goals"; while another said ASSETS "made me have a clearer direction for grade 11 and 12 and shown me what sort of careers are in a STEM field". Many students commented on the information about potential STEM careers that ASSETS provided, "I got a lot of information [from] my meeting the STEM professional and learning future careers" and "... you get a lot of information...to help you with your future if you were to choose a STEM career". STEM professionals noted that the program focus on students gaining working experience with a science professional was the most beneficial aspect for students because at that stage of their lives, high school students had limited ideas what they wanted out of life, including career options. This is somewhat in opposition to many of the students' quite specific career aspirations, although these aspirations may require adjustments for constraints as yet unknown to the students. Program staff noted one method that ASSETS utilised to bridge the divide between aspirations and expectations among participants was the inclusion of Mentors who were attending university and who could share the challenges of living away from home, balancing work and study, and managing family expectations.

The leadership program element of ASSETS was initiated during the 2016-17 summer schools and continued to be developed and bolstered in 2018. This element is aimed at contributing to supporting students' career aspirations. For example, 29 work placements for former ASSETS participants had occurred in 2018, representing 66 per cent of students who requested a placement. One ASSETS alumni had "recently attended a Boeing work placement because of ASSETS". Another student felt their work placement had "helped me to better understand the environment of a workplace and opened my mind to other career options".

3.2 Better understanding of, and confidence in pursuing, STEM career pathways

3.2.1 Understanding of STEM career pathways

There is strong evidence that students' understanding of STEM career options and pathways increased as a direct result of ASSETS. In the online survey, one student said, "I loved learning about so many other peoples' careers. It was not what I was expecting; I was expecting to hear [about well-known professions like health and medicine] but it really opened my eyes on what other jobs there are". Another student concurred how ASSETS had expanded their understanding of future career options, "It [ASSETS] can definitely widen your perspective of university and possible job opportunities". This theme of broadening perspectives was also exemplified by another student, "Returning from the ASSETS summer school I came into school with more of an understanding of the different array of soooo many other jobs I hadn't even thought about doing". With broadened perspectives, some students made corresponding changes, "I have higher social confidence and a better knowledge in STEM careers. ASSETS has presented with me a better perspective of what I want to do in the future, and made me rethink what uni[versity] courses I wanted to take".

Program staff preferred to take the analytical approach in terms of directing students to particular career paths. One staff member saw themselves as a "source of information", "ask[er of] questions", someone to "get.... to know them on a personal level". Another staff member described their role as putting the pieces of the puzzle together for students who already had an idea of what they wanted to be but just required someone to help transform those wishes and dreams into a practical reality.

According to program staff, the ASSETS program stood the chance of providing students with a better understanding of, and confidence in pursuing, STEM career pathways[14] because it was facilitated by highly qualified and skilled individuals. They pointed to professionals from CSIRO Energy as an example. As STEM professionals, they were delivering a program which they had purpose-designed for those age groups. They had put a lot of thought and time into their presentations because they had a vested interest in the outcomes of the program. That is to say, if they presented the learning program effectively to students, it was likely a greater number of students would be encouraged to follow a scientific path which, in turn, would mean a broader pool of potential applicants for CSIRO projects.

Participating STEM Professionals added a different dimension to the importance of students working together in groups in terms of progressing in a STEM career. They held the view that, in the scientific world, individuals could not progress unless they worked in teams. It was a priority, therefore, for students to learn how to share their opinions with others and be able to receive and understand other opinions in their cohort. One STEM Professional gave the example of how, although they themselves were regarded as having achieved much in the scientific world, they could not have done it without collaboration with others to solve problems.

3.2.2 Confidence pursuing STEM career pathway

In addition to increased understanding, ASSETS contributed to the confidence of ASSETS participants and alumni. One ASSETS alumni thought that "[t]hrough attending the ASSETS program....[it] assisted....me having the courage to apply for other jobs. It has helped me secure a cadetship which would not have been possible without the ASSETS program". Another example is a student who identified that "[a]fter attending I felt my confidence rise as well as becoming more aware of the many pathways to a STEM career". Another said that ASSETS "showed us several ways how to prepare for year 11 and 12 and also life after school, whether that was applying for a job or attending university". Another student explained that being exposed to other people with similar interests had boosted their confidence: "It has shown me that I'm not alone and that there are others out there just like me. It has impacted me in that I would love to go deeper into medicine in the way that I may even consider doing a research type job for Indigenous people and . . . community". ASSETS also stimulated confidence in other, similar academic realms. One student said that they applied for a course at a university that was similar to the content at ASSETS and "this experience has therefore helped me achieve within that [other] course".

Parents of ASSETS alumni also noted increased self-confidence in their children to pursue their goals. One parent thought that after attending ASSETS: "He grew up so much. He came home with increased self-confidence and determination to do well to achieve admission to university". Another parent marvelled at their child's change in personality "...in such a short space of time, [it] was astounding. His independence and confidence surprised us all". Finally, another parent thought their child "has a much better understanding of the potential of environmental science....and generally a clearer idea of what he may want to do".

Responses in the interviews indicated that a better understanding of, and confidence in pursuing, STEM career pathways was related to career advice provided to students. STEM Professionals believed that career advice early in a student's school education was decisive in the chances of a student becoming a successful scientist. They went on to add that students did not necessarily have to be high academic achievers in order to achieve success. What students needed was to learn what was required in their chosen pathway in terms of work ethic and how best to work in a team. According to academic providers, until enrolment in the ASSETS program, students were mainly taught how to succeed as individuals in individual assessments and examinations.

STEM Professionals were keen, however, to emphasise that while it is valuable to give students insight into the options for the future, the ultimate goal of the program should be to teach students "good life skills such as a positive work ethic". They believed that a sound work ethic was the key to achievement. Some STEM Professionals held the view that attitudes needed to be inculcated in students that they needed to work their way through a career path. Students also needed to learn how to work in teams; develop a good understanding of managing relationships; and have a sense of career direction. Students should be allowed, however, to "find" themselves because the "shock" of leaving school and doing something different can be quite challenging for students according to a STEM Professional.

14 Comparing the pre and post surveys for the 2016-17 and 2017-18 summer schools, there was an overall increase of 33 per cent (from 65 to 99 per cent) and 46 per cent (from 47 to 93 per cent) in the proportions of respondents (n = 66 and n = 57) who had '...a good understanding of STEM careers'.

An important component of the ASSETS program in shaping students' perception of future careers was the fun component. Program staff thought that students did not have much fun in science at school. It was important that the program attempted to balance that perception by showing the practical side of science, and how it could lead to a rewarding career. What mattered was that the professionals showing students how science was going to be beneficial to the students in relation to their future careers. One program staff member suggested that the "whole point of it is exposing them to something that they don't get exposed to at school". Numerous students also talked about how "fun" the science activities were "you're just there to learn and have fun; so it definitely is a different environment to school".

Program staff held the view that students formed part of setting the standards that they could achieve in the program, and that this was part of the confidence building process. Program staff decided on the minimum expectations in terms of attendance, but students decided on how well they would achieve a task. Program staff, however, did focus on how they could push students to achieve more without them feeling uncomfortable. One member of the staff stated that they had to constantly assess if they were pushing students too far: "It's not about pushing people into places they don't want to be. But we know that if they remain comfortable, there isn't growth. So it is that fine line, again, about rising to challenges and seeing [them] rise to the challenges they set for themselves".

Program staff were keen to point out that, when students set their own standards, this was part of the process of handing over ownership of learning back to students. According to program staff, it was important to guide students to understand exactly how the standard that they had set for themselves eventually impacted on what they could do with their learning. Students appeared to appreciate the responsibility that came with the freedom of setting their own standards. One student stated: "I think the challenge is good because if it's too easy, especially for me, I will just slack off. I wouldn't put a hundred per cent in. I would just breeze by". There was also some evidence that students were challenged at a level that did not result in them doubting their ability as is evident in this student's response: "It's still a level where it's just a bit higher than what I'm capable of which is great because then it gives me room to ask questions and improve on what I do and what I can achieve so I really enjoy it".

There was some evidence that developing confidence in students was the main target for some program staff. According to one member of staff, if students were able to "build their confidence in things like public speaking, social confidence, and ability to build relationship across their peer group and with the numerous adults in various capacities" then they would have taken a significant step towards success. Another member of staff agreed that confidence was crucial for success even though they could conclusively say that this alone would not be adequate for students to qualify in their chosen careers.

Confidence changes were already starting to be evident in students over the nine days of the program. Program staff could see this in the completion ceremony where it was quite evident that students were ecstatic that their hard work had paid off. At this ceremony, program staff noticed that even people intimately related to participating students were themselves surprised by the confident way that some of the students presented their work. To staff, witnessing students' transformation into confident young people was rewarding; and was largely attributed to confidence building from the very first day. As one staff member described, students were consistently given the message that "...you can be anything you want to be. What you want to be, if you just put your mind to it, you can do it. It's a really positive environment".

Finally, in addition to increased awareness, knowledge and confidence, there were also self-reported increases in skills. Students frequently mentioned increased skill levels in public speaking, interpersonal and teamwork skills, leadership skills, management skills, writing skills, inquiry skills, and organisational skills. One student also mentioned that the newfound skills could be used in other areas: "The best part of the camp was the one-on-one discussion with some of the STEM professionals...[who] showed me that some skills can be used for other things".

3.3 Greater confidence in cultural identity and the relevance of culture for STEM careers

3.3.1 Confidence in cultural identity

The cultural component of ASSETS is intended to allow students an opportunity to connect with their culture (if they were not currently strongly connected) or to further enhance an existing connection, while exploring links between Aboriginal and Torres Strait Islander science and Western science. Interviewees and respondents to the on-line surveys concurred about the value of the cultural components of ASSETS, and how it advanced confidence. One alumnus thought that ASSETS had "greatly improved… cultural connection," while another thought that ASSETS helped in "[d]iscovering who I was as a person and also developing more self-confidence around people". For another student, taking part in the cultural activities "gave me a sense of cultural belonging". In addition to belonging, ASSETS also spurred curiosity among some students:

"Well, it makes me think a lot more about the culture and want me to learn more about the other things that they've done, not only just for science, but other things that they've created, they've made. And it makes me want to go back and try and learn that way; not always the Western science way."
(Student)

> Parents of ASSETS alumni concurred with their children's views. One parent said "My son….came back asking to do an Ancestry DNA tracker. The ASSETS program increased his cultural identity". Another parent noted that their child "had always struggled with his cultural identity, he often stood back and hadn't really wanted to be recognised or had the confidence to do so. He has definitely come back from the ASSETS program different. He has become more involved in his dad's life and learning more about their culture".

Program staff noticed that students who appeared to have closer associations with their Indigenous heritage found it easier to make connections between their Indigenous knowledge and current learning. These students were therefore the ones making quicker progress. However, as much as it seemed that students' awareness and connection with culture was important to their learning, schools appeared to be struggling to support students adequately in this regard. One student said: "If we want like actual knowledge about our Aboriginal culture and stuff we have to go seek our Aboriginal Elder at the school, or go to like an Aboriginal Elder outside the school".

It was not uncommon therefore for students to have had minimal or no connection to culture, and that their participation in the program would have been "the first opportunity school kids get to learn about their culture". As further demonstration of this point, in one of the cultural activities, a program staff member noticed that only two out of thirteen girls had previously participated in cultural dancing prior to the ASSETS program.

It was clear that many students' schools did not include any integration with, or even examples of the relevance of, Indigenous scientific knowledge to Western science. One student stated: "Putting science into Aboriginal culture – I didn't really think of it before here [ASSETS]. It's not something my school talks about". Another student thought their school did not stress the link enough "in terms of Indigenous science relating to Western science".

The ASSETS program therefore appeared to be a learning experience where students were able to "find themselves".[15] The education program was an opportunity for students to explore their cultural identity. One student exclaimed "I love it [because]…I know nothing about my culture. I don't even know where I originate from".

Cultural confidence appeared to be a prerequisite for some students making good progress, feel confident and have high aspirations. Program staff noticed that those students who were highly familiar with their culture were most often the ones to integrate with other students and complete tasks the quickest. A member of the program staff related a conversation with one student who was already committed to understanding their Indigenous heritage. The ASSETS program motivated them to go a step further and talk to a wider network of Aboriginal and Torres Strait Islander people in the quest to "link it all" according to the student. A member of the program staff said that the confidence to engage with a wider group of students beyond the insular group was a good measure of success of the program.

STEM Professionals noticed that when students found the learning program to be relevant to their own cultural and personal contexts they were likely to be more engaged in the program. A STEM Professional described the enthusiasm shown by such a student being "super engaged" and recalled the student saying: "This is something we need in my community because it's so expensive to get electricity in there so if we can get solar that would be a huge benefit for that community".

Program staff considered the cultural homogeneity of the groups of students to be instrumental in students gaining confidence to engage with cultural knowledge. In the process, they grew closer to each other in terms of working as teams. A member of the program staff described what they observed in this regard: "They're engaging with their culture which they all seem to absolutely love. They're having a great time and when you're having fun you want to engage with what's going on a lot more. I think they are definitely engaging with science a lot more here".

Students affirmed that the observations by program staff regarding the enjoyment they got from participating in the culturally homogenous group were accurate. Several different students stated that at the summer school, "I enjoy meeting other people that in the same boat as me"; "you don't feel like they're judging you"; and that they liked the "Indigenous side of it", and being where other students "that don't shun you because you get certain [social] benefits".

However, some students found that, while it was good to have met such a wide cohort of Aboriginal and Torres Strait Islander students, the cultural approach followed in the learning program was very superficial and not enough to make a difference. A student stated that "when it came to learning, they related it to Aboriginal stuff all the time. They didn't have time to go into detail about the actual learning part of it, which is probably why I would prefer high school, in terms of learning".

15 Comparing the pre and post surveys for the 2016-17 and 2017-18 summer schools, there was an overall increase of 29 per cent (from 55 to 83 per cent) and 16 per cent (from 63 to 79 per cent) in the proportion of respondents (n = 66 and n = 57) who knew '… where to learn more about my culture'.

Another student agreed and stated that the cultural component of a learning program could only be significant if it was far more comprehensive. In the ASSETS program, the cultural component was relatively basic, leading some students to be sceptical of its effectiveness. A student who only learned the Indigenous name for a didgeridoo thought that this knowledge was a "bit useless". The same student went on to state that they were always told "Language is so important!" but they were now inclined to say, "It's not really important if you only know a small amount of it".

One member of staff stated: "I think the cultural part of it is done extremely well....and I think that is really important, and the kids got as much out of that as they did from the science part of it". Another member of staff thought that "...the inspirational thing for these kids was to be in a group of 33 other kids who connect with being Aboriginal and Torres Strait Islander, and the cultural stuff was really inspiring for them".

A student appreciated the way current scientific knowledge and practice was linked to history, especially Aboriginal and Torres Strait Islander history. Students were generally unaware of how modern science drew so much from Indigenous scientific knowledge. One student stated that they had "zero awareness of links". A comment by another student indicated that the reason for the lack of awareness of the role of Indigenous scientific knowledge is that the current school curriculum is dominated by "science from the Western perspective".

3.3.2 Relevance of culture for STEM careers

Students did not frequently articulate the links between culture and STEM careers, which may be linked to Year 10 students being relatively early in their career development and planning. However, there was some understanding of the significant scientific basis for Aboriginal and Torres Strait Islander culture: "I've always believed my culture was a scientific culture. It's always been that...We realised what aerodynamics were when we made our weapons like boomerangs and things like that. We weren't this primitive, barbaric, nomadic culture, we were a smart group of people, and I'd always known that, and coming here just gave me more evidence to show that to make my point to people". Another student stated that "[t]hrough this program I have discovered Aboriginal culture involves many degrees of science". In contrast, one student did not "understand the link between STEM and the Aboriginal culture" and felt "they contradict each other".

Students often talked about ASSETS benefiting them in terms of STEM careers and cultural identity, but as separate concepts: "I began to see a pathway that I wanted to pursue, as a career. Not only this, but I realised how broad and complex science is. I noticed myself becoming more connected with my Aboriginality, and a spark ignited in me, that caused me to be incredibly passionate about finding out about my family". Similarly, another student separately mentioned that "ASSETS gave me a great opportunity to further connect with my culture, as well as learning interesting scientific concepts/theories". One student did make the connection: "I believe the connections between STEM and our Indigenous Culture isn't at its full potential just yet, but if it continues on the path that it is on now, I feel as if it will come together sometime in the near future". It is possible that most students did understand in a general manner the relevance of culture for STEM careers, but did not explicitly link them in their thinking or responses.[16]

One finding that was clearer was that students were inspired by the role modelling of the ASSETS program patrons and mentors. One student said "I chose to be a teacher due to the inspiration I received from the ASSETS Team and Mentors, and they were role models in my life. It inspires me to make an impact in lives the way they impacted mine". Another student said: "Thanks to the mentors and their stories of how they got where they are, I have developed more determination to work towards university and complete school to the best of my ability". Another ASSETS alumni thought that "...the mentors were so inspiring. Where they have come from and what they have achieved".

Related to this, some students wanted to succeed in the program because of the network of people that looked up to them as role models. Family were "proud, like really proud" said one student. The student went on to say "everyone goes up to my mum and dad and they're like, your daughter did very well. She's very involved with her culture". Program staff saw the respect as the primary reason for students to relate to others in this way. Aboriginal and Torres Strait Islander students, according to the staff member, were known to have respect for family. The staff member said that, when people "respect themselves", "respect others around them" and "respect the place that they're at" they become the focus of attention within and beyond the program, role models deserving of respect.

16 An additional program monitoring methodology – a semi-structured interview – will be introduced for ASSETS alumni commencing in late 2019. The interviews will explore this topic in more detail.

Students were able to make immediate connections between learning content, careers, and their personal lives and backgrounds. A STEM Professional recalled his interactions with a student they described as "super engaged". The student was able to relate the potential benefits of an experiment to the improvement of the quality of living in their own community. The intrinsic connection the student had with the experiment fuelled a commitment quite unlike that associated with students who just wanted to meet assessment requirements. Students were helped to understand that they could have meaningful careers where they could one day be employed not only to earn an income but to also make a significant contribution to the communities they loved.

3.4 Growth in student and professional networks

3.4.1 Student networks

ASSETS participants had diverse sizes and types of pre-existing student networks, ranging from non-existent to relatively strong, but all localised. One student related the low base they were coming from in terms of networks with other students with similar interests and backgrounds: "I don't really have many friends at school, and I think only two are interested in science, and neither are Indigenous. I only have Indigenous friends from here [ASSETS]. I don't have any other Indigenous friends". Another student noted that they had a network of other students interested in science, but that it was limited: "... do you have a STEM support network...? Yeah. Only like a couple of people, but, yeah, it's still kind of cool". Other students had strong networks already, substantiating the diversity of ASSETS participants: "I have lots of friends [at school] who share my interest in science... There's definitely a lot of scientific people at our school who want to pursue a career in science..."; and "We're all into STEM, but we're all into different parts...We're just all really a mixed group that supports each other".

ASSETS provided an opportunity to develop or grow student networks. One student offered that "[i]t's been nice having a group of like-minded individuals from a similar background as a support network". Students indicated that, if they were to gain from the program, it was important to be surrounded by other competent students. One student considered other students at the program to be "more into science than at school". The student added that this was an advantage because, at school, not only were they in the company of some students who were not interested in school but students that had interests in subjects other than science. Another student went further and thought ASSETS had "...provided me with life-long friends".

Parents of ASSETS alumni also noticed the growth in student networks: "It [ASSETS] was really positive, she...is in constant contact with everyone on her camp, the support network will be very beneficial for all their futures". Another parent noted that their child enjoyed "the opportunity to network with like-minded students from around Australia".

Responses by students indicated that that the program environment offered students new opportunities to build future networks among themselves. Central to the togetherness and willingness to work with each other was the level of acceptance they enjoyed within the cohort. There appeared to be no discrimination between students, something which they commonly experienced outside the cohort. One student stated: "Yeah, and no one discriminates here. Like, between each other, about our pigments and stuff – everyone is just like, you're either Aboriginal or you're not".

There was some indication, too, that students appreciated the inclusivity of the program. Some students felt that their own schools had been largely culturally unresponsive, and that they felt excluded from schools' mainstream programs and social fabric. Occasional activity nights and school social events were seen by some students as tokenistic. Even the breakfast club at school where students got to socialise over meals felt isolating, leading one student to comment that "you're mainly on your own". Inclusivity of the ASSETS program, on the other hand, gave students confidence to network – "...they don't judge each other" remarked one student and "everyone's in the same boat" stated another.

The internalisation of high expectations and a personal commitment to succeed were considered by program staff to be of similar importance to the academic benefits of the program. It brought students out of their inner self and empowered them to find common relationship threads with others. A staff member stated: "the inspirational thing for these kids was to be in a group of 33 other kids who connect with being Aboriginal and[/or] Torres Strait Islander". Program staff gave examples of students that had entered the program with feelings of insecurity but had grown in confidence over the duration of the program. Students confirmed that they had seldom worked so intensively with others before, and therefore would not have made connections with their peers as they had done since commencement of the program.

Students started to show first signs of stepping out from one network to another as they felt less restricted to participate in established groups only. Students spoke of how they had always been introverts and preferred the company of people they had known for a long

time. In this program, however, although students were initially inclined to choose only tasks that their friends or acquaintances had chosen, they found themselves fitting well in new groups. This was captured aptly by one student: "At school I'm pretty much an introvert most of the time but for some reason here I just find it easier to be around people who I haven't met before". One of the benefits that students had noticed in stepping out into new groups was that tasks previously considered too complicated were now interesting challenges tackled with new friends.

However, stepping out into new networks was not without its challenges for students. Program staff observed a period of harmony where all students were polite with one another while initially forming relationships. During this time, they began to understand their own places within the group, as well as their own strengths and the strengths of others. However, as challenges arose within their groups, students' relationships were noticed by program staff to be "push[ed] past polite [ness] all the time" and then later for strained relationships to be "built back up again".

Comments by students indicated that that they were happy to be in the company of a large cohort of other Aboriginal and/or Torres Strait Islander students, with some of them indicating that it was their first time experiencing this situation. Students were motivated by the "togetherness" of the group according to a program staff member. The camaraderie was enhanced by the small sizes of groups and the duration of the summer school that enabled students to form close bonds with each other and the time to grow relationships, leading one student to comment that they were "really loving it". Another student noted that "I liked how you had to stay with someone. You got to know them, and then over the course of the nine days, you'd start to learn and make friends".

The ASSETS Facebook group had grown and had been used to engage with 290 students in relation to opportunities and information. Of the ASSETS alumni on this page, 90 per cent were classed as active group members. Although not all ASSETS alumni used or were familiar with the Facebook page, some students appreciated the ability to maintain contact with the network of ASSETS alumni:

> "I…have loved the connection Facebook page has provided to allow communication between participants….and also sharing individuals' achievements in science and technology. This has impacted the way I motivate myself towards my students…I regularly keep in contact with ASSETS Participants as they impacted my life in just a positive way. I love to check up and show support to them in their achievements in life and just to re-spark the connection that was kindled on the ASSETS Summer School". (Alumni)

3.4.2 Professional networks

The growth of students' professional networks was also evident in their responses to the interview questions and surveys, but was not as strongly identified as student networks (friendships). One student said "I think the ASSETS summer school made me slightly more outgoing around strangers and professionals in fields and has given me more confidence to talk to people at networking events…" Another student thought that ASSETS had "further developed my ability to meet and work with people while learning to adjust to new situations I would otherwise not go for".

Students appeared to understand the potential benefits of their wider professional networks. One student stated that the wider networks were important in any future career because "it's all about who you know". Another student spoke of how the wider network that they had stepped into in the program could, in turn, be useful in forming even wider networks. This student said: "I know these people who know people – we can use their connections". All these steps taken to widen their horizons were helped by the fact that students could use their personal devices to link up with each other through social media, including the ASSETS Facebook group. The excitement of being able to do this is captured by this student's response: "[W]e just take our phones out and boom, boom, boom. We've got some photos, and working with everyone, especially because everyone is from different states and everything – it's amazing".

Students highlighted that, of particular interest to them, was their proximity to professionals succeeding in making careers out of their interest in science. Students saw these professionals as ordinary people with whom they could identify. They also felt privileged to be able to have personal dialogue with them and there was some indication that students considered the opinions of STEM Professionals to be quite significant. One student commented: "They [STEM Professionals] were really cool to meet. That was really amazing. They're really smart people and just to be able to meet with them and do the activities with them and they taught us how to use all the equipment". Another student thought meeting and building a relationship with a STEM professional was "the best part of the camp".

Program staff saw the wider networking of students with STEM Professionals as an important step in the orientation of students towards careers. While staff acknowledge that parents and extended family played an important role in orientation, they were of the opinion that people outside students' immediate circle (e.g., from industry or other sections of the university), could

play an instrumental role in preparing students for future careers. It appears that ASSETS allowed students to network effectively with STEM professionals, leading to both an increase in awareness of the importance of professional networks, and gains in networking skills. Therefore, although it may have been too early for students to have established professional networks in the years proceeding ASSETS, the program provided the confidence and skills to develop them when the timing was more appropriate.

3.5 Increased community, parental engagement

Before discussing the findings related to parental and community engagement, it is important to briefly review how students were engaged in ASSETS. Students appeared to internalise the positive experience of the program environment, especially the high expectations of the program. They started to self-reflect on their roles within the network of students and staff. Program staff felt that self-reflection seemed to have led to renewed vigour in students to make a success of their engagement with the program content. A program staff member recalled how he observed a number of students going back to their rooms at night and studying, learning, reading, and preparing for the next day. The staff member added "they seem[ed] just really engaged and really happy to be doing it". Compared to school, some students felt ASSETS was more engaging: "...I think it was more engaging and probably because it was like this isn't everyday school, this is a camp that was you might get in, you might not get in...So I was like 'Yeah, I should pay attention to everything here' instead of at school where I might daydream a little bit because I know that I can just come back in a week or two and learn it again. This camp felt very exclusive".

Several students also noted a range of parental engagement in their schools. One student commented that parents and families were only involved "if something bad has happened. That's the only time. Parents usually stay away". Another student noted that only a small minority of parents were involved at school on the P & C but "that's about the extent of how the parents help the school". Another student felt that parents did not need to be involved: "... if I ask my parents, they would be involved, but I feel like they don't need that push. And to be honest I feel like that I don't need them to be at school to do stuff because ... if I really need something...I will do that option if I really need to". A parent noted that they wanted the opportunity to be more engaged with the school: "I believe we need more of a voice when making decisions for our children. Not many opportunities to be involved in committees".

3.5.1 Increased parental engagement

Parents of ASSETS participants received a positive view of the program from the outset, due in large part to the messages relayed by program staff. The information provided to parents gave clear signals that the program intended to engage students holistically, and that it would be inclusive of parents and the participants' communities. The cultural and social elements of the program also helped engage parents. For example, family members of participants often acted as helpers, with a program staff member commenting that "there's almost as many helpers than as there are students". In addition, some family members of participants (e.g., parents, Aunties) facilitated sessions and workshops; proactively made community connections through work placements; and attended or helped with a cultural immersion day on-country, where participants interacted with community members and leaders and a dinner night on-campus with Elders.

Program staff noted that while many participants were well supported by their families at home prior to and during the summer school, often family members travelled to the summer school location to continue their support. Family members who had experience in higher education or professional careers[17]in particular seemed to have the background knowledge to be able to easily engage with the program and support their children, grandchildren, nieces, nephews, younger sibling, etc. There were also many students who applied for summer schools after their older sibling attended in a previous year, suggesting that those families value the opportunity and continue to be engaged and supportive of participation in the program.

The invaluable role of family in the management of students' mental wellbeing was also obvious. Program staff stated that sometimes contact with parents revealed more than just what was communicated by students in their written applications for entry into the program. Staff quoted examples of working with students who had complex familial backgrounds, with support working best after close consultation with students' families. This confirmed the approach of contacting families, where appropriate, to support students who were facing challenges.

Program staff also spoke of the benefits of parental engagement prior to commencement of students in ASSETS, primarily in terms of preparing for and personalising the experience for students. For example, one staff member made extensive contact beforehand and performed significant research on individual students, including speaking to parents. This staff

17 The parent surveys (n = 96) showed a range of education levels of participants' parents. 42 per cent of parents/caregivers who responded had not completed Year 12 but around 24 per cent had completed a university degree.

member was able to call students by name from the start of the summer school and make connections between students and their homes, which resulted in students feeling welcome and included.

Both students and program staff spoke of the potential of technology to generate more interaction with families and the wider community. Program staff, for example, spoke of the possibility of live streaming students' performances to parents to enhance communication. Program staff quoted success in live streaming events to the most remote communities in Australia to emphasise this point.

Consultations with students, their families, and teachers commenced well before the summer school, and sometimes went beyond advice about the summer school. This was demonstrated by a program staff member who provided advice to a teacher at a student's school concerning one of the students in Year 12 who was thinking of changing from ATAR equivalent subjects, and who wanted to know if the student would still be able to get into university. Other parents and teachers asked ASSETS program staff enquired about the Bachelor of Science (Extended) program delivered by the University of Melbourne. Staff members also counselled parents and students when students were "losing motivation or enthusiasm and wanting to know if there were programs out there that might get that spark going again". One staff member explained that liaising with parents about the logistics of the summer school provided a non-threatening starting point to build a relationship that, over time, could grow into exploring non-summer school related issues, if appropriate. It was also noted that ASSETS program staff needed to find a balance when seeking to engage parents in terms of building the independence and responsibility of participants.

3.5.2 Increased community engagement

ASSETS had multiple impacts on community engagement including with local people, most prominently in engaging a range of community members in the ASSETS program itself. ASSETS involved Academic providers, STEM Professionals, program patrons, mentors (including ASSETS alumni), and Elders/traditional knowledge holders/ community leaders in the nine-day residential component of the program. As previously discussed, the engagement of mentors and STEM professionals was highly valued by students. ASSETS participants also found the involvement of Elders to be a highpoint of the program. One student said: "The highlight for me...was seeing the Elders quite often and being able to learn so much culture through them". A parent echoed this feeling: "[My child] love[d] hearing from Elders and learning the ways of the past". One student liked hearing from Elders from a different area: "I am used to speaking to my community Elders and going through our practices and beliefs, although coming to a completely new town with different traditions was eye opening. I had the opportunity to understand different dreaming stories and beliefs". The presence of Elders in the program "lit a spark" in students according to program staff. Students related to program staff how they enjoyed talking to "uncles" and were able to "celebrate" being Indigenous in light of past achievements of Indigenous people. Program staff believed that the input by Elders provided the perfect catalyst to launch students towards career aspirations.

STEM Professionals and academic providers were engaged and pleased to be a part of the program. For example, one STEM professional was particularly fond of being able to transmit their knowledge to students: "I've worked in the industry for so long, I really enjoy...pass[ing] on what I know and see...." In addition, the freedom to undertake experiments and activities without reference to a rigid curriculum was also appealing to some STEM professionals.

There was some evidence of students having the intention to increase their engagement with stakeholders in their home communities as a result of participating in ASSETS. One student mentioned that when they got back home, they would be working with local Indigenous organisations to find out more information about their family history and culture. Two other students explained that they would be going back home with an excitement about culture and sharing it with their families. Another student felt the summer school experience allowed "for me to become a role model in my community", which implies a desire for further community engagement. One student expressed an interest in undertaking research and projects in their community that "mean something to my people". ASSETS team members agreed that ASSETS provided the skills and experience for students to further engage in their communities, for example by "put[ing] their hand up if their school wants them to do something for NAIDOC".

4 Discussion

The ASSETS program was developed with the intention to support the participation and achievement of Aboriginal and Torres Strait Islander students currently taking part in STEM subjects. The program has met all the intended outcomes (within the scope of this evaluation) to varying degrees. Perhaps one the most relevant overall indicators of success is that the majority of surveyed participants found its impact to be significant, and often life changing, in terms of their study and career directions.[18] ASSETS has in place the key success factors for a STEM residential program aimed at Indigenous young people, including a strength-based approach that connects participants to what they already know about science; being intentional about exploring cultural identity and linking local Indigenous scientific knowledge to Western Science, and the critical role of Elders and cultural leaders in connecting them; and well prepared and trained staff and academic providers to deliver the science/inquiry and cultural components.[19] These factors have been important in making ASSETS a success. The key themes of this case study research have been distilled in the following sections covering: STEM careers; Indigenous knowledge/cultural identity; and networking/engagement.

4.1 STEM careers: aspirations, understanding and confidence

The ASSETS program has had a substantial positive impact on participants' aspirations, understanding, and confidence in pursuing a STEM career, including intermediary educational goals. ASSETS provided the information, learning atmosphere, and activities to support students along their pathways to STEM careers. Participants were more aware of the diversity of STEM careers that were available to them and had increased awareness of the university pre-requisites required to pursue relevant qualifications. For many students, ASSETS strengthened their existing plans; for other students, ASSETS led to changes in careers directions. Working in teams during the summer school also provided students with an insight into how working in a STEM occupation would operate in reality.

Through ASSETS, students were given the opportunity to experience a university setting and an initial orientation to potential career options. Success in STEM degrees and careers is a multi-faceted process that is dependent on factors through-out multiple stages of a student's life. These factors (and stages) can include: parents fostering early interest (early years); strong introduction to science and inquiry (primary school); teachers that motivate and support student aspirations (high school); out-of-school STEM experiences (primary and high school); supported transitions and informal support systems (university); and effective mentors (early career) (Gandhi-Lee, Skaza, Marti, Schrader, & Orgill, 2015; Mau, 2016; Wang & Degol, 2013). Clearly, ASSETS has a targeted and time-limited impact on students, most intensely during the summer school component, but also ongoing through the leadership and support component. However, facilitating positive experiences for young people in STEM is one of the most effective ways of increasing interest in these careers; and summer camps and schools that use hands-on activities in which science is connected to everyday lives is key way to build these experiences (Crombie, Walsh, & Trinner, 2003).

Having a wrap-around support system throughout the ASSETS program, particularly during the summer school element, increased student trust and engagement, as well as likely openness to new experiences. ASSETS staff supported students' transitions to the summer school; and provided valuable and personalised information to parents. This was especially important as Years 10, 11 and 12 are critical times in terms for preparing students for the transition to university and to highlighting career possibilities.

18 A majority of respondents (n = 38) to the destination survey thought the influence of ASSETS on their study and career directions was 'life changing' (29 per cent) or 'a lot' (53 per cent); only 18 per cent of respondents felt ASSETS had 'a little' impact.

19 See Gamble (2014) for a similar Canadian example.

A number of barriers exist in relation to Aboriginal and Torres Strait Islander students attending university (and by definition entering subsequent professional careers), including first-in-family issues (lack of guidance in relation to university from family members); complexity of education and career pathways; a perceived lack of benefit for some students; distrust of government institutions; and poor experiences with school career counsellors (Day & Nolde, 2009; Gore, 2017). ASSETS has played a part in addressing many of these issues – for example, by exposing students to information to demystify pathways, and, to Aboriginal and Torres Strait Islander role models to demonstrate the benefits of a STEM career; and by providing work placements after the summer schools. The ASSETS program staff, Program Patron and Mentors were genuinely committed to student learning; and their expertise meant that students received a tailored curriculum as well as the appropriate support to assist achieving their ambitions.

Raising students' academic readiness is a key priority for succeeding at university (Pechenkina, Kowal, & Paradies, 2012). ASSETS contributed to this, including increasing awareness and understanding; enhancing students taking ownership of their own journey; and generally raising students' confidence and expectations of themselves. Raising the expectations and self-perceptions of students can increase the likelihood of engagement and achievement in the program and beyond; but it is important that the high expectations are relationship-based (Sarra, 2016). At a more practical level, students gained more of an understanding of the requirements of university, including pre-requisites, which also contributed to an overall confidence and self-efficacy that will be useful in future as students navigate educational and professional pathways. The increased confidence among participants was also readily apparent, which can play a major role in a students' successful negotiation of future challenging situations (Frawley, Ober, Olcay, & Smith, 2017).

The real-world application of the content, including applied inquiry and hands-on work, were important in providing participants with the understanding and skills that a STEM career would require. It will be important for future summer schools to provide a 'reality check', as unrealised aspirations may become a reality, and compromises occur immediately after school for many students. Inexperience and lack of self-knowledge can frustrate the career planning of school leavers; and therefore, developing resilience to assist them manage disappointments, life skills to manage post-school world, and ability to visualise different futures for themselves is critical (Hall et al., 2015; Walker, 2006).

4.2 Indigenous (scientific) knowledge and cultural identity

The ASSETS program successfully linked Indigenous science knowledges and practice to the science curriculum. The program also increased many participants' confidence and curiosity in their cultural identity, which was important because many students had little exposure to cultural information from their families or schools, due to in part to the impact of colonisation. Students felt comfortable in the ASSETS environment that fostered culturally appropriate content. Although many students benefited greatly from the cultural identity activities, there needs to be more investigation into how effective it is to include this in the curriculum, particularly as it includes only relatively basic information. It is an assumption of the ASSETS programs that students require a foundation of cultural knowledge to fully and effectively engage with the program; that is, to be able to make connections between Indigenous scientific knowledge and Western scientific systems. However, given the summer school is a relatively brief introduction to the former, there is a risk that this knowledge is conceptualised too simplistically or generically[20] (Nakata, 2007).

Having Elders, community leaders, and/or traditional knowledge-holders present was reported to be extremely helpful to students, increased their engagement, and went a long way to ensuring a discernible Indigenous voice was present. Responses by participants and program staff indicated that much of the success of the ASSETS program may be attributed to the Program Team, and Program Patrons and Mentors, organising and participating in the program. According to one staff member, the program owes its success to "student mentors, senior mentors in the form of university Indigenous unit contributions, the contacts and networks that they bring, the expertise they bring". According to another member of staff, the ability of Indigenous leadership to "walk and fly in both worlds is incredible".

Many students felt that the content was more relatable and engaging due to the inclusion of links to Indigenous scientific knowledge, culture, and practices. The ASSETS program appears to have carefully planned the cultural components, and avoided the pitfall raised by Nakata (2007) of simply adding "Indigenous components to the mix". The ASSETS program builds on students' prior Indigenous knowledge, which ranged from non-existent, or not revealed, to relatively deep and open among the summer school participants. This prior knowledge was seen and treated as a valuable strength among staff and students, which was then built on over the

20 Indigenous scientific knowledge is based on individual and collectively learned experiences and explanations of the world.

course of the program. The inclusion of Indigenous scientific knowledge and Western science together has provided students an opportunity to skilfully understand, navigate, and operate in 'both worlds' (Fergie, 2018), although it may make more sense to conceptualise this as operating in two systems in one world.

The interface between Indigenous and Western scientific knowledge is complex and contested. Working in this space is challenging, and in response ASSETS has been allowed to be iterative and improve over its stages of development, over time, and in different locations. As a result, there has been a multitude of opportunities to increase engagement through program improvements suggested by the various stakeholders. One area for further deliberation is the balance of cultural, academic, and leadership activities within the program. Another area for consideration is ensuring Aboriginal and Torres Strait Islander scientific knowledge is embedded in, rather than bolted on to, the curriculum (Riley, Howard-Wagner, Mooney, & Kutay, 2013). Educational systems designed to Western standards can provide limited motivation to Aboriginal and Torres Strait Islander people; and can, in fact, lead to feelings of disrespect and marginalisation (Korff, 2018). A solution to this issue, which ASSETS takes, is to embed both Western knowledge and Aboriginal and Torres Strait Islander scientific knowledge in curriculum and activities to allow students to navigate both and build on their strengths and successes. Given most students did not express understanding of the links between culture and STEM careers, it will be important to make more explicit links in future.

4.3 Networking

The high levels of engagement and the creation of new networks among participants can be in part attributed to the fact that students were surrounded by a cohort with similar goals, interests and worldview, which was often in contrast to the cohorts students experienced in their home communities. In addition, students felt well supported by the staff, with mention that they felt comfortable to approach the staff about general questions and career advice. This atmosphere of trust, support and positivity was conducive to the formation of networks; and, just as importantly, could contribute to students' decision to continue along a STEM pathway. For example, a single positive experience has been found to have a significant long-term impact on a student's decision to persist in STEM disciplines (Watkins & Mazur, 2013).

Staff mentioned that it was integral for students to include, and have the support and engagement of, families to attend the summer school. There is evidence that this family support, particularly parent attitudes during students' high school years, are related to post-secondary STEM success (Hinojosa, Rapaport, Jaciw, LiCalsi, & Zacamy, 2016). More generally, family is the most important setting outside of school in shaping student's academic motivation and career interests (Wang & Degol, 2013). ASSETS provided strong support to students and parents, which facilitated some parents contacting the team and for some, getting involved. However, it appears that more can be done to include parents and caregivers, as invitations alone are often not enough to lead to parental engagement. In addition, some parents are unclear about what role they could have in their children's education and feel inadequate to undertake this role (Woodrow, Somerville, Naidoo, & Power, 2016). These feelings of inadequacy arise from experiences of racism; and can be exacerbated by feelings of misaligned values, as the values fostered by educational institutions do not always corresponded with the values important to Aboriginal and Torres Strait Islander students and parents (Higgins & Morely, 2014). As greater parental involvement in children's learning and education activities leads to better outcomes for the child, and their families, teachers, schools, and wider community (Sartbayeva, 2016), it will be important for ASSETS to explore ways to enhance parents' role in ASSETS and their children's education more generally, and to make schools safer places for Aboriginal and Torres Strait Islander students.

The development of confidence in students was integral to the level of engagement and the development of the students' budding professional networks and skillsets. The summer school supported the passion that the students already had to be a part of STEM, and gave them the opportunity to be independent and steer their own learning, likely to a far greater degree than in school. In concert with this, students were provided with an environment to network with other students, giving them an opportunity to not only build their student and professional networks but also potential support networks. Many students had little to no opportunity to speak with other Aboriginal and Torres Strait Islander students interested in STEM before the summer school. This is important because there are indications that, in general, students are many more times as likely to enrol in university if their friends do (Choy, 2002). Aboriginal and Torres Strait Islander students need a strong cohort who can support each other throughout school and into university (The Aurora Project, 2011). Building nascent networks with other students and professionals gave students the opportunity to see what different professions looked like, which was important because these careers were often outside of their immediate networks.

5 Conclusion and recommendations

ASSETS is effectively achieving the intended goal of providing opportunities to high achieving Year 10 Aboriginal and Torres Strait Islander students to explore study and career options in STEM. In line with the strengths-based approach of this case study research, several recommendations to build on these achievements are offered in Table 7.

Table 7. Summary of what is/are working well, some challenges, and ideas to consider going forward

OUTCOME(S)	WHAT IS WORKING WELL	CHALLENGES	IDEAS TO CONSIDER GOING FORWARD (RECOMMENDATIONS)
High aspiration for STEM career, including Subject choice referencing prerequisites for university STEM courses	The atmosphere, activities and support that ASSETS has in place has contributed to the confidence and self-efficacy to achieve STEM education and career aspirations among participants.	Barriers still exist for ASSETS alumni to achieve their STEM aspirations. ASSETS has a highly intensive interaction with students during the summer schools component, but more limited contact in Years 11 and 12 through the leadership support component, which is dependent on students' levels of motivation and interest to be involved.	ASSETS to assess the levels and types of participant educational and career aspirations (and expectations) to gain a better understanding of the tailored information and supports students require at the summer school and beyond. ASSETS program staff to continue to work closely with parents/teachers/schools to support students' aspirations in Year 11 and 12, including expanding supports where feasible (e.g., wider promotion of professional pathways and supporting higher occupational certainty).[21]
Better understanding of and confidence pursuing STEM career pathways	ASSETS is providing information and a confidence building environment that is leading to participants increasing their knowledge and confidence of pursuing STEM pathways, including university and careers.	ASSETS' resources and impact are concentrated on the summer school component, with lower investment in the post-summer school period, which may diminish impact over time.	Further build the Leadership and Support component of ASSETS, particularly: continuing to enhance the work placement component; increasing ASSETS alumni participation in CREST; and increasing the number of STEM professionals who are Aboriginal and/or Torres Strait Islander (to provide positive role models).[22] ASSETS to provide information to participants' schools on forming relationships with the STEM Industry to (1) better inform ASSETS participants and alumni, for example on the particular STEM skills that will be in demand in future[23]; and (2) expose industry to a pipeline of high achieving Aboriginal and Torres Strait Islander students interested in STEM.

21 See Cohen, Patterson, Kovarik and Chowning (2013) for general examples of how to equip teachers to support students pursuing STEM careers.

22 Several Aboriginal and/or Torres Strait Islander STEM Professionals/role models have been involved in the program to date. The recommendation is aimed at building and expanding on this involvement.

23 See Department of Education and Training (2017) for discussion of optimising STEM Industry-School partnerships.

OUTCOME(S)	WHAT IS WORKING WELL	CHALLENGES	IDEAS TO CONSIDER GOING FORWARD (RECOMMENDATIONS)
Greater confidence in cultural identity and the relevance of culture for STEM career	The cultural component of ASSETS is well received and valued by participants, with strong links to the science activities and curriculum.	The cultural interface between Indigenous and Western knowledges is complex and not easily navigated by program staff or participants. In addition, given some students have very little cultural knowledge before commencing ASSETS, the amount of information may be insufficient to make strong links to the curriculum.	Continue to build the Aboriginal and Torres Strait Islander leadership of the program at all levels. Review the cultural component of ASSETS to ensure it is effectively embedded and seamlessly integrated throughout the curriculum (i.e., not only as a stand-alone component). Include more information and examples of how culture relates to STEM careers, including explicitly dispelling myths about culture and STEM careers and providing examples of how culture can assist STEM career pathways.
Growth in student and professional networks	Students are making strong links with other participants and with STEM professionals.	Maintaining and expanding student and professional networks is challenging due to the disparate locations of participants and difficulties program staff have keeping alumni engaged post-summer school.	Provide additional support for students to build professional networks when the timing is right, including one-on-one support from ASSETS staff, assisting with linking more formally with mentors/role models (STEM professionals from ASSETS or STEM professionals in students' home communities), and using additional (besides Facebook) social media platforms frequently used by students.
Increased community and parental engagement	Parents are engaged with the logistics of ASSETS and students are talking about the ASSETS experience with their parents. Many STEM professionals, ASSETS alumni, and Elders are actively engaged in the program.	The disparate geographic locations of participants makes continuing engagement difficult, particularly with stakeholders in specific communities. Some parents of ASSETS students are engaged, but the involvement is often focused on the logistics of the summer school.	Consideration be given to encouraging a 'community-inspired' element to the students' inquiry projects (that arise out of particular community's needs where students originate from, and which responds to many students' desire to help solve issues and address community problems), which has the potential to connect the summer school project to students' home community, including STEM professionals and teachers.[24] Examine ways to support further parental involvement – for example opportunities for parents to connect with each other through technology or facilitating stronger engagement with students' schools (where increased parental engagement is appropriate).

24 See Dalbotten et al. (2014) for an example from the United States.


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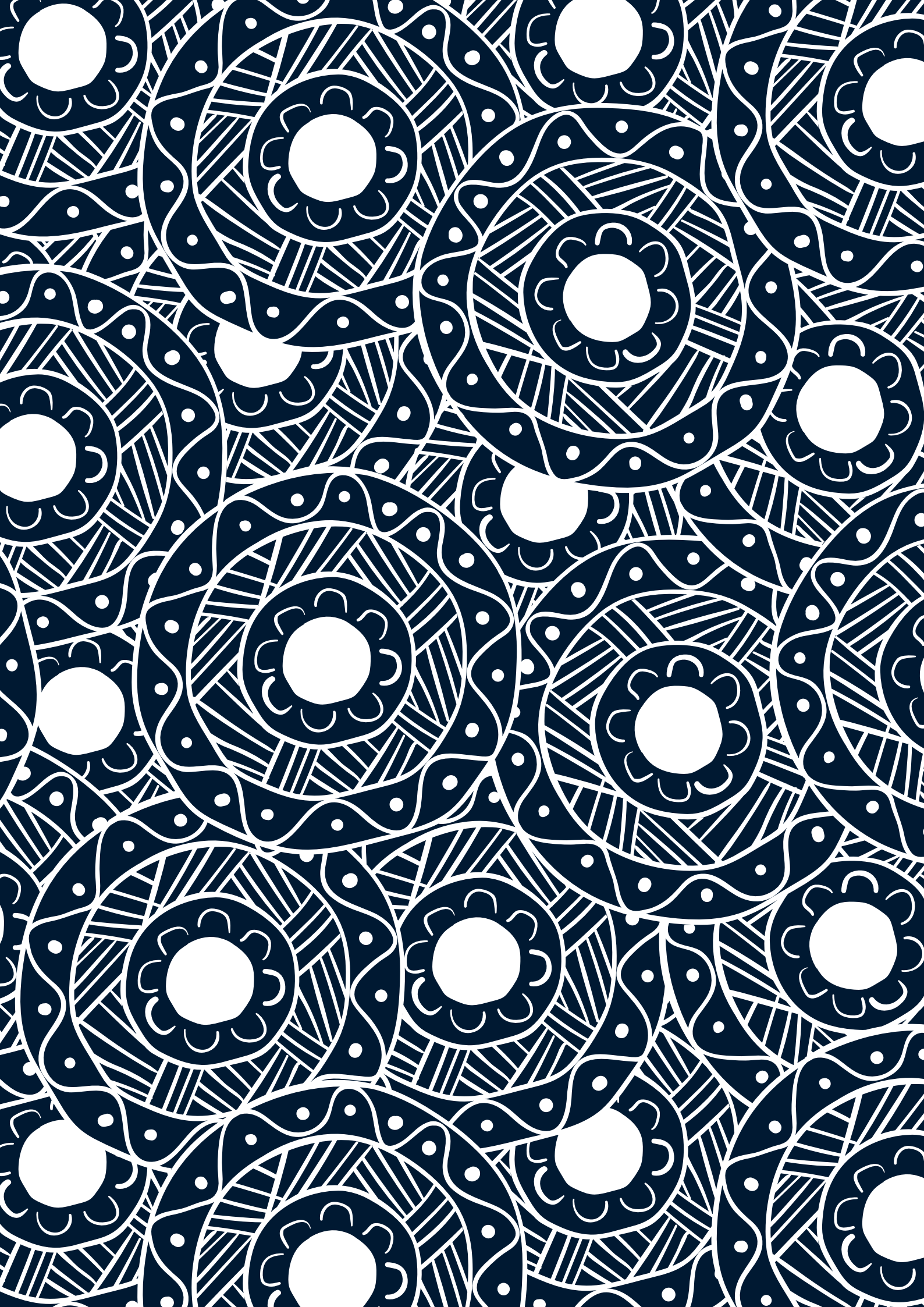
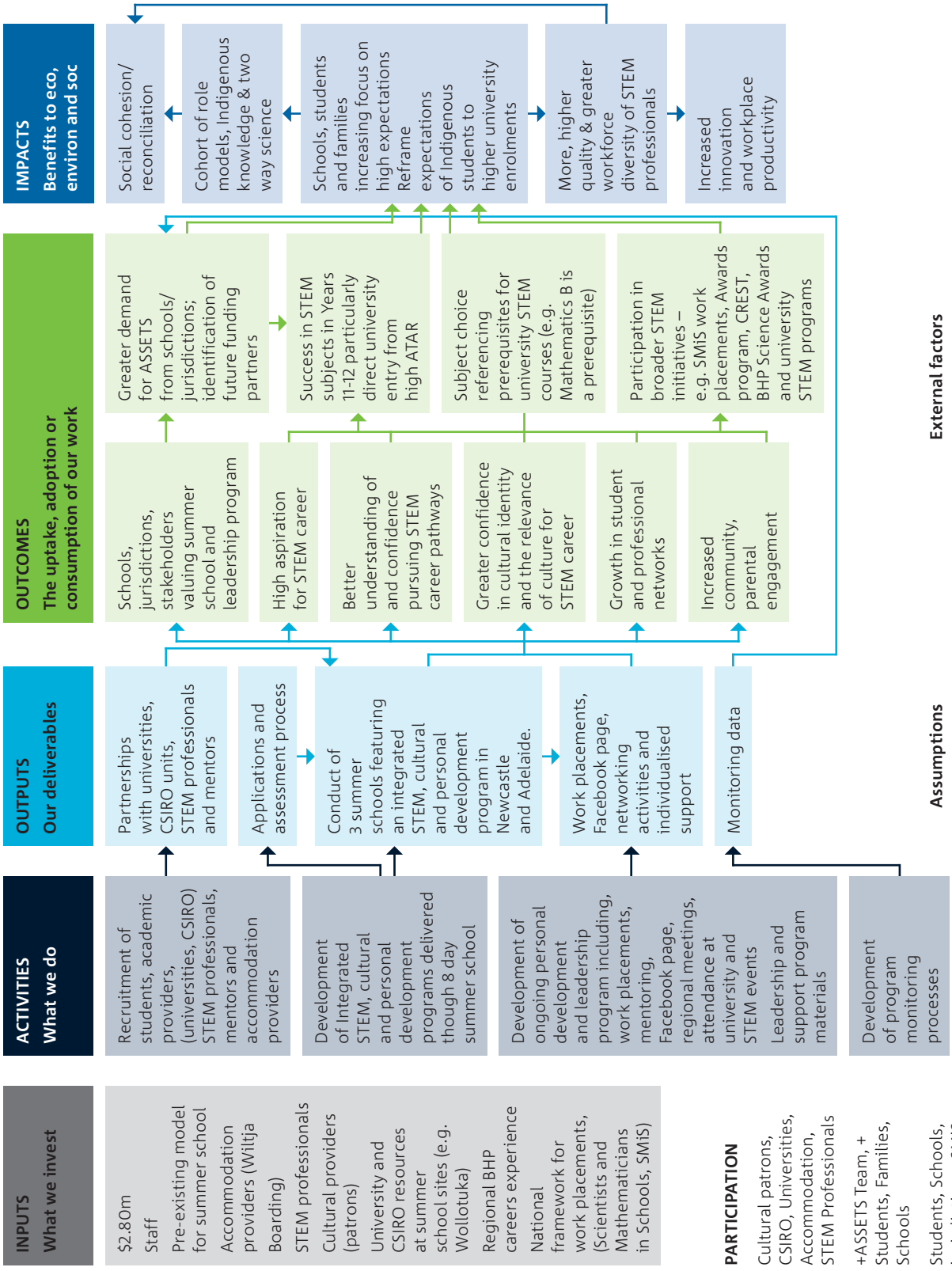


Appendices

Appendix A

Aboriginal Summer School for Excellence in Technology and Science (ASSETS) Impact Pathway



Appendix B

Typical ASSETS Summer School Timetable

	DAY 1	DAY 2	DAY 3	DAY 4	DAY 5	DAY 6	DAY 7	DAY 8	DAY 9
Session 1 **9.00-10.00**		Opening and Welcome from Program Patron	Cultural activity[25]	Site visit to Academic Provider 1	Site visit to Academic Provider 2	Inquiry work and presentation preparation	Inquiry work and presentation preparation	Leadership and Support session 2	
Recess **10.00-10.30**									
Session 2 **10.30-13.00**		Leadership and Support session 1	Cultural activity	Site visit to Academic Provider 1	Site visit to Academic Provider 2	Inquiry work and presentation preparation	Inquiry work and presentation preparation	Leadership and Support session 3	
Lunch **13.00-13.30**	Students arrive								
Session 3 **13.30-15.00**		Inquiry Kickstarter Session 1	Meet a STEM Professional	Site visit to Academic Provider 1	Site visit to Academic Provider 2	Inquiry work and present preparation	Final preparation and presentation rehearsals	Site visit to science facility 3	
Recess **15.00-15.20**			Afternoon tea with STEM Professionals						
Session 4 **15.20-17.30**		Inquiry Kickstarter Session 2	Inquiry Kickstarter session 3	Site visit to Academic Provider1	Site visit to Academic Provider 2	Inquiry work and present preparation	Final preparation and presentation rehearsals	Prepare for Celebration Dinner	
Dinner / Evening Activity **18.00-19.00**	Welcome dinner	Cultural and/ or STEM activity	Leadership and Support team building session	Cultural and/ or STEM activity	Cultural and/ or STEM activity	Cultural and/ or STEM activity	Cultural and/or STEM activity	Celebration Dinner	

Inquiry group presentations

Students leave

25 Cultural activities are related to scientific concepts to varying degrees.

Appendix C

Summary of residential STEM enrichment programs for Aboriginal and Torres Strait Islander students

The summary covers the key STEM enrichment programs in Australia aimed at Aboriginal and Torres Strait Islander students. It is not intended to be a comprehensive overview of all programs (see Office of the Chief Scientist, 2016b for a more comprehensive catalogue). The summary is based on publicly available information only. CSIRO does not accept any responsibility or liability for the accuracy, completeness or reliability of this information.

PROGRAM	DELIVERY PARTNERS	PURPOSE
Aboriginal Summer School for Excellence in Technology and Science (ASSETS)[26]	• CSIRO • University of Newcastle • University of South Australia • James Cook University	• Allow students to explore study and career options in STEM • Strengthen cultural connections
STEM Camps[27] / STEM Youth Development Camps[28]	• NSW Aboriginal Education Consultative Group Inc. • NSW Department of Education • Connected Communities • Aboriginal and Torres Strait Islander Mathematics Alliance	• Teach STEM through cultural lens to inspire students • Support students to achieve academic outcomes at school • Students access post-school learning and employment pathways in STEM
InspireU Junior STEM[29]	• University of Queensland	• Pique interest of junior students in STEM • Provide practical insight into STEM disciplines
National Indigenous Science and Engineering Summer School[30]	• ANU Tjabal Centre • ANU College of Science • ANU College of Health and Medicine • ANU College of Engineering and Computer Science	• Experience university life • Obtain program and career advice • Speak to expert staff • Interact with Indigenous students and staff • Encourage participation in STEM university study
Indigenous Australian Science and Infrastructure Development School[31]	• QUT (Science and Infrastructure Development School) • WSP • Oodgeroo Unit	• Explore post-school options • Break down myths and barriers around attending university • Build aspirations
Koori STEM Camp[32]	• University of Wollongong • NSW Government – Transport for NSW • Woolyungah Indigenous Centre	• Identify with Aboriginal cultural heritage and its connection to STEM • Develop stronger sense of identity, connection, pride and empowerment
Residential Indigenous Science Experience (RISE) [33]	• University of Melbourne • Agilent Technologies • GTAC	• Inspire interest in STEM career • Learn about science technology

26 www.csiro.au/en/Education/Programs/Indigenous-STEM/Programs/ASSETS/About-ASSETS

27 www.aecg.nsw.edu.au/policies-and-programs/stem-camps/

28 https://education.nsw.gov.au/teaching-and-learning/aec/news/category-one/2018-stem-youth-development-camps

29 https://atsis.uq.edu.au/future-students/inspireu-programs/inspireu-junior-stemhttps:/atsis.uq.edu.au/future-students/inspireu-programs/inspireu-junior-stem

30 https://science.anu.edu.au/reconciliation/student-opportunities/national-indigenous-science-and-engineering-summer-school

31 www.sidschool.com.au/

32 https://news.eis.uow.edu.au/event/koori-stem-camp-november-2018/

33 https://science.unimelb.edu.au/home/engage/community-quick-links/science-in-schools/rise

ACTIVITIES	LOCATION	DURATION (DAYS)	PARTICIPANTS
• Tailored cultural activities • Meet and work with expert STEM professionals • Work in a team on scientific investigations	University campuses	9	• High achieving Year 10 students • 105 students annually
• On country activities, storytelling	Recreation centres in regional locations	3	• NSW Department of Education students in regional and remote areas • 130 students annually
• Information and interactive workshops	University campus	6	• Year 9 and 10 students with high attendance and interested in undertaking OP eligible pathway
• Hands-on activities across science and engineering disciplines	University campus	8	• Year 10 and 11 students from across Australia with interest in STEM subjects and careers
• Meet current students • Visit real world work sites and meet industry professionals • Participate in interactive university faculty activities	University campus	5	• Year 10, 11 and 12 students • 30 students annually
• Bush walks with Elders • Exploring science behind traditional activities/objects • Site visits to research centre	Camp	4	• Year 9 and 10 students from Illawarra • In 2018 Year 10 and 11 students from NSW South Coast
• Exploring science facilities • Hands-on science workshops • Meet university student mentors • Attend lectures	University campus	8	• Year 9 and 10 Indigenous students interested in science

PROGRAM	DELIVERY PARTNERS	PURPOSE
Indigenous Australian Engineering School[34]	• Curtin University • Engineering Aid Australia	• Opportunity to discover benefits of engineering
Santos Karnkanthi Indigenous Engineering School[35]	• University of Adelaide	• Expose students to engineering • Introduction to university life • Experience with two family members
Science, Health & Engineering Camp[36]	• University of Western Australia	• Interweave cultural themes with participation from Indigenous scientists, engineers and health professionals
Bunga Barrabugu Spring STEM Program[37]	• The University of Sydney	• Extension of the Indigenous Student Engineering Spring Workshop • Encourage increased participation of Aboriginal and Torres Strait Islander students in STEM
Indigenous Science and Engineering Program (ISEP)[38]	• University of New South Wales • Nura Gill Indigenous Programs Unit	• Experience UNSW's Faculty of Science and Faculty of Engineering • Broaden experience • Peak interest and inquiry
Strengthening Engagement and Achievement in Mathematics and Science – Indigenous Early Years Program and VCE Program[39]	• Monash University • The University of Melbourne	• Aims to increase equitable participation and attainment in science and maths in higher education
Victorian Indigenous Engineering Winter School (VIEWS)[40]	• The University of Melbourne	• Expand perspective on engineering
JCU Winter School for Australian Aboriginal and Torres Strait Islander Students[41]	• James Cook University	• Experience university life

Note: All programs are residential based. Only programs specifically focused on STEM have been included.
This summary is intended to provide an overview of opportunities; it is not comprehensive.

34 https://scieng.curtin.edu.au/about-us/outreach/indigenous-australian-engineering-school/
35 www.adelaide.edu.au/wirltu-yarlu/schools/engineering-school/
36 www.sis.uwa.edu.au/outreach/camp
37 http://sydney.edu.au/wpo/indigenous/stemex.shtml
38 www.nuragili.unsw.edu.au/isep
39 www.vaeai.org.au/_uploads/_cknw/files/SEAMS%20Flyer.pdf
40 https://eng.unimelb.edu.au/engage/indigenous/views
41 www.jcu.edu.au/events/2018/july/winter-school

ACTIVITIES	LOCATION	DURATION (DAYS)	PARTICIPANTS
• Forum to meet engineering role models • Experience engineering studies and careers	University campus	7	• Year 10, 11 and 12 students with interest and aptitude towards engineering, science and mathematics • 22-30 Students annually
• Structural engineering visits • Sports engineering with sports persons • Coding and robot activities	University campus	5	• Year 11 and 12 students interested in STEM (particularly engineering)
• Hands on experiences of science, engineering, medicine and technology • Careers forum • Information session on selecting school subjects	Urban location	5	• Year 10 and 11
• Hands-on • Team work on cross-disciplinary project • Science and Maths enrichment workshops • Industry site visits	University campus	6	• Year 11 students
• Variety of fun activities and interactive learning	University campus	3	• Year 7–9
• Interactive workshops • Academic sessions	University campus	Indigenous Early Years Program – 2 VC Program – 3	• Year 8 and 9 Indigenous students enrolled in VCE Mathematical Methods and a Science subject • Students from participating schools • 40 students annually for Indigenous Early Years • 100 students annually for VCE program
• Industry visits • Exploring study options at Uni's • Hands-on workshops • Insight into global challenges	University campus	6	• Year 11 and 12 Indigenous students who are enrolled in Maths and Science subjects • 26 students annually
• Academic lecture and tutorials • Presentations • Study Sessions • Team-building activities	University campus	5	• Year 10, 11 and 12

Appendix D

ASSETS case study questions (interviews and focus group)

STEM PROFESSIONALS

Student questions

1. How long have you been in your current position?
2. Do the students find the curriculum engaging? (Hints: relevant to their everyday lives).
   a. How does this contrast with other teaching experiences you have been involved in?
3. What do you think of the support at ASSETS?

Individual (STEM professional) questions

4. Have you previous experience in Indigenous education?
5. Are you confident in delivering inquiry curriculum to this group of Aboriginal and/or Torres Strait Islander students?
6. Have you thought about the Indigenous context of your material?
7. Was the ASSETS briefing important in assisting you with delivering your curriculum?

Work (rather than School) questions

8. Do you engage with Indigenous education issues in your work environment? (Please elaborate)
9. How does it compare with your involvement in ASSETS? (How do you feel?)
10. Do you have a philosophy of high expectations?
11. Do you feel equipped and comfortable working in an Indigenous program?

Family/Community questions

12. How have you engaged with families/community in your teaching practice? Is this important to you? Why?

STUDENTS

Student questions

1. How does learning STEM at ASSETS compare with your school?
2. What do you like/not like?
3. Do you like learning about Indigenous science knowledge? Why?
4. Have you thought much about the link between your culture and western science previously? How has ASSETS contributed to your thinking in this area?
5. Do you ask for help when you don't understand something? How do you feel asking for help?
   a. How does this compare with seeking help at school?
6. Does your science teacher relate science to your everyday life?

School questions

7. Does your school expect you to do well?
8. Do you have a peer network that's interested in STEM? How does this compare with ASSETS?
9. Does your school teach about Indigenous culture in other subjects? How does this feel?
10. Generally, do Aboriginal and/or Torres Strait Islander and non-Indigenous students get on well at your school?

Family/Community questions

11. Does your school have a sense of community?
12. Do parents and families feel welcome? Do they get engaged? Is it different for Indigenous and non-Indigenous families?

PROGRAM STAFF AND PARTNERS/

Student questions

1. Do the students find the science curriculum engaging? (Hints: relevant to their everyday lives).
2. Based on your discussions with students does this contrast with their regular science curriculum?
3. How has the personalised support at ASSETS worked? (Hint: What does this look like?).
4. How does it compare with other programs you have worked on?

Individual (teacher) questions

5. How confident are the STEM professionals you work with in delivering inquiry curriculum and targeting it to a group of Indigenous students?

School/ASSETS questions

6. How do the students compare their summer school experience with that of their regular school?
7. Do you have a philosophy of high expectations?
8. Do you feel equipped and comfortable working in an Indigenous program?

Family/Community questions

9. How does the relationship with the family support the program? How does it evolve over the course of the summer school and broader leadership program?

Appendix E

Survey data

The following tables contain a summary of the data from the online surveys for ASSETS participants (pre and post), parents, and alumni.

2016–17 Summer Schools: Pre and Post Participant Responses

SECTION	QUESTION	STRONGLY AGREE OR AGREE (PER CENT)			NEUTRAL (PER CENT)			STRONGLY DISAGREE OR DISAGREE (PER CENT)		
		PRE	POST	CHANGE	PRE	POST	CHANGE	PRE	POST	CHANGE
Knowledge of STEM	I feel a strong connection between science and my Aboriginal and Torres Strait Islander culture	50.0	80.3	+30.3	47.0	18.2	-28.8	3.0	1.5	-1.5
	I think STEM is important for my community	90.9	95.5	+4.5	7.6	4.5	-3.0	1.5	0.0	-1.5
	I have a good understanding of STEM careers	65.2	98.5	+33.3	30.3	1.5	-28.8	4.5	0.0	-4.5
Your identity	I am proud of my Aboriginal and/or Torres Strait Islander identity	98.5	98.5	0.0	1.5	1.5	0.0	0.0	0.0	0.0
	I am aware of practices and beliefs that are relevant to my culture	66.7	75.8	+9.1	21.2	21.2	0.0	12.1	3.0	-9.1
	I am involved with practices and beliefs that are relevant to my culture	33.3	51.5	+18.2	40.9	33.3	-7.6	25.8	15.2	-10.6
	I know where to learn more about my culture	54.5	83.3	+28.8	27.3	13.6	-13.6	18.2	3.0	-15.2
	I am comfortable discussing my Aboriginal and/or Torres Strait Islander culture with others	86.4	95.5	+9.1	13.6	3.0	-10.6	0.0	1.5	+1.5
	In general, I feel safe expressing my cultural identity at school	86.4	86.4	0.0	10.6	12.1	+1.5	3.0	1.5	-1.5

SECTION	QUESTION	STRONGLY AGREE OR AGREE (PER CENT)			NEUTRAL (PER CENT)			STRONGLY DISAGREE OR DISAGREE (PER CENT)		
		PRE	POST	CHANGE	PRE	POST	CHANGE	PRE	POST	CHANGE
About your future	I have the potential to be a role model/ mentor for young Aboriginal and Torres Strait Islander people(s)	86.4	89.4	+3.0	12.1	7.6	-4.5	1.5	3.0	+1.5
	I am interested in going to university in the future	93.9	97.0	+3.0	6.1	3.0	-3.0	0.0	0.0	0.0
	I am interested in going to TAFE in the future	16.7	22.7	+6.1	43.9	37.9	-6.1	39.4	39.4	0.0
	I would like to work full time rather than study after leaving school	15.2	12.1	-3.0	28.8	30.3	+1.5	56.1	57.6	+1.5
	I am unsure about what I want to do in the future	24.2	22.7	-1.5	25.8	15.2	-10.6	50.0	62.1	+12.1
	I intend to study a STEM field at university	63.6	84.8	+21.2	34.8	15.2	-19.7	1.5	0.0	-1.5
	I intend to have a career in STEM	48.5	81.8	+33.3	51.5	18.2	-33.3	0.0	0.0	0.0
	I know what a prerequisite subject is	72.7	92.4	+19.7	9.1	3.0	-6.1	18.2	4.5	-13.6
	I know what the pre-requisite subjects are for what I want to study at university	50.0	86.4	+36.4	30.3	7.6	-22.7	19.7	6.1	-13.6
	I know how to apply to university	47.0	74.2	+27.3	33.3	13.6	-19.7	19.7	12.1	-7.6
	My family or extended family can assist me with information about university studies	80.3	86.4	+6.1	10.6	7.6	-3.0	9.1	6.1	-3.0
	I know where/how to find information about a career that interests me	86.4	90.9	+4.5	13.6	7.6	-6.1	0.0	1.5	+1.5
	I am capable of being successful at university	93.9	92.4	-1.5	6.1	6.1	0.0	0.0	1.5	+1.5
	I think I can afford to go to university if I choose to do so	50.0	53.0	+3.0	36.4	36.4	0.0	13.6	10.6	-3.0
	Choosing a STEM career is more difficult than most other career options	19.7	28.8	+9.1	74.2	50.0	-24.2	6.1	21.2	+15.2

Note: Only participants who responded to both the pre- and post-surveys were included. n = 66 for all questions.
The 'Strongly Agree' and 'Agree' categories, and 'Strongly Disagree' and 'Disagree' categories have been combined for brevity.

2016–17 and 2017–18 Pre-Survey Responses

DEMOGRAPHIC AND BACKGROUND QUESTIONS	2016–17 SUMMER SCHOOLS		2017–18 SUMMER SCHOOLS	
	YES (PER CENT)	NO (PER CENT)	YES (PER CENT)	NO (PER CENT)
I am Aboriginal (n = 70 and 75)	97.1	2.9	96.0	4.0
I am Torres Strait Islander (n = 71 and 72)	15.5	84.5	12.5	87.5
I have been to a science camp before (n = 71 and 75)	18.3	81.7	26.7	73.3
I have been on a university campus before (n = 72 and 75)	75.0	25.	77.3	22.7
Someone in my family or extended family has been to university before (n = 64 and 67)	84.4	15.6	88.1	11.9
I have a parent or other role model who is working or studying in a STEM field (n = 62 and 60)	17.7	82.3	26.7	73.3
WHY DID YOU APPLY FOR ASSETS? (N = 72 AND 75 FOR ALL QUESTIONS)				
I am interested in the science and technology aspects of ASSETS	88.9	11.1	73.3	26.7
I am interested in the cultural and leadership aspects of ASSETS	73.6	26.4	65.3	34.7
I want to meet people with similar interests to mine	63.9	36.1	54.7	45.3
I thought it would help my future education	86.1	13.9	81.3	18.7
I wanted to attend a summer school away from home	16.7	83.3	21.3	78.7
Someone (e.g. teacher, friend, family member) recommended it to me	76.4	23.6	80.0	20.0
HOW DID YOU HEAR ABOUT ASSETS? (N = 72 AND 75 FOR ALL QUESTIONS)				
School teacher/counsellor	69.4	30.6	65.3	34.7
Indigenous Education worker	26.4	73.6	33.3	66.7
Principal	9.7	90.3	0.0	100.0
School notice board/newsletter	1.4	98.6	4.0	96.0
Community Indigenous organisation	1.4	98.6	1.3	98.7
Friend	5.6	94.4	10.7	89.3
Family member	22.2	77.8	16.0	84.0
Internet	1.4	98.6	0.0	100.0
Newspaper	0.0	100.0	0.0	100.0
HELP WITH APPLICATION				
Did you get help from anyone when completing your application? (n = 65 and 63)	53.8	46.2	57.1	42.9

LENGTH OF SUMMER SCHOOL	TOO SHORT (PER CENT)	JUST RIGHT (PER CENT)	TOO LONG (PER CENT)
How did you find the length (number of days) of the summer school?	35.8	56.7	7.5

Note: n = 67 (from 2016-17 Summer Schools only)

How did you find the quality of the following aspects?

	2016–17 SUMMER SCHOOLS (N =77) (PER CENT)					2017-18 SUMMER SCHOOLS (N = 67) (PER CENT)				
ALL SUMMER SCHOOLS	VERY GOOD	GOOD	OK	BAD	VERY BAD	VERY GOOD	GOOD	OK	BAD	VERY BAD
Applying for ASSETS	72.7	26.0	1.3	0.0	0.0	56.7	35.8	6.0	1.5	0.0
Accommodation	35.5	30.3	27.6	6.6	0.0	35.8	53.7	10.4	0.0	0.0
Food	42.9	40.3	15.6	1.3	0.0	38.8	26.9	26.9	7.5	0.0
Camp rules (e.g., phones, bed time)	35.1	23.4	29.9	9.1	2.6	20.9	29.9	43.3	1.5	4.5
Staff	92.2	6.5	1.3	0.0	0.0	85.1	11.9	3.0	0.0	0.0
TOWNSVILLE (N = 20)	VERY GOOD	GOOD	OK	BAD	VERY BAD	VERY GOOD	GOOD	OK	BAD	VERY BAD
Applying for ASSETS						65.0	30.0	5.0	0.0	0.0
Accommodation						65.0	30.0	5.0	0.0	0.0
Food						55.0	30.0	10.0	5.0	0.0
Camp rules (e.g., phones, bed time)						45.0	30.0	25.0	0.0	0.0
Staff						95.0	5.0	0.0	0.0	0.0
NEWCASTLE (N = 23)	VERY GOOD	GOOD	OK	BAD	VERY BAD	VERY GOOD	GOOD	OK	BAD	VERY BAD
Applying for ASSETS						56.5	39.1	4.3	0.0	0.0
Accommodation						26.1	69.6	4.3	0.0	0.0
Food						43.5	21.7	30.4	4.3	0.0
Camp rules (e.g., phones, bed time)						13.0	34.8	43.5	4.3	4.3
Staff						91.3	8.7	0.0	0.0	0.0
ADELAIDE (N = 24)	VERY GOOD	GOOD	OK	BAD	VERY BAD	VERY GOOD	GOOD	OK	BAD	VERY BAD
Applying for ASSETS						50.0	37.5	8.3	4.2	0.0
Accommodation						20.8	58.3	20.8	0.0	0.0
Food						20.8	29.2	37.5	12.5	0.0
Camp rules (e.g., phones, bed time)						8.3	25.0	58.3	0.0	8.3
Staff						70.8	20.8	8.3	0.0	0.0

	2016–17 SUMMER SCHOOLS				2017–18 SUMMER SCHOOLS			
ALL SUMMER SCHOOLS	HIGHLY VALUABLE	VALUABLE	OK	NOT VALUABLE	HIGHLY VALUABLE	VALUABLE	OK	NOT VALUABLE
Intro to inquiry (Fire starting)	36.8	43.4	19.7	0.0	28.4	58.2	11.9	1.5
STEM careers and university information	76.3	21.1	2.6	0.0	59.7	35.8	4.5	0.0
First academic provider	52.6	40.8	6.6	0.0	53.7	35.8	9.0	1.5
Cultural Activity 1	67.1	27.6	5.3	0.0	47.8	35.8	14.9	1.5
Second academic provider	69.7	27.6	2.6	0.0	47.8	35.8	11.9	4.5
Meeting STEM professionals	86.8	9.2	3.9	0.0	71.6	20.9	6.0	1.5
Cultural Activity 2	63.2	28.9	7.9	0.0	64.2	28.4	6.0	1.5
Cultural Activity 3	56.8	29.7	13.5	0.0	54.2	27.1	16.9	1.7
Inquiry projects	63.2	28.9	7.9	0.0	65.7	28.4	4.5	1.5
Celebration dinner	77.3	20.0	2.7	0.0	74.6	10.4	13.4	1.5
Final presentations	80.6	16.7	2.8	0.0	65.7	25.4	9.0	0.0
TOWNSVILLE	HIGHLY VALUABLE	VALUABLE	OK	NOT VALUABLE	HIGHLY VALUABLE	VALUABLE	OK	NOT VALUABLE
Intro to inquiry (Fire starting)					55.0	45.0	0.0	0.0
STEM careers and university information					60.0	35.0	5.0	0.0
First academic provider					50.0	35.0	15.0	0.0
Cultural Activity 1					70.0	20.0	10.0	0.0
Second academic provider					65.0	35.0	0.0	0.0
Meeting STEM professionals					70.0	25.0	0.0	5.0
Cultural Activity 2					70.0	25.0	5.0	0.0
Cultural Activity 3					75.0	15.0	10.0	0.0
Inquiry projects					80.0	20.0	0.0	0.0
Celebration dinner					65.0	10.0	25.0	0.0
Final presentations					80.0	5.0	15.0	0.0

	2016–17 SUMMER SCHOOLS				2017–18 SUMMER SCHOOLS			
NEWCASTLE	HIGHLY VALUABLE	VALUABLE	OK	NOT VALUABLE	HIGHLY VALUABLE	VALUABLE	OK	NOT VALUABLE
Intro to inquiry (Fire starting)					13.0	60.9	26.1	0.0
STEM careers and university information					47.8	47.8	4.3	0.0
First academic provider					47.8	52.2	0.0	0.0
Cultural Activity 1					30.4	52.2	13.0	4.3
Second academic provider					39.1	43.5	13.0	4.3
Meeting STEM professionals					65.2	26.1	8.7	0.0
Cultural Activity 2					56.5	43.5	0.0	0.0
Cultural Activity 3					40.0	33.3	26.7	0.0
Inquiry projects					60.9	39.1	0.0	0.0
Celebration dinner					82.6	8.7	8.7	0.0
Final presentations					52.2	39.1	8.7	0.0
ADELAIDE	HIGHLY VALUABLE	VALUABLE	OK	NOT VALUABLE	HIGHLY VALUABLE	VALUABLE	OK	NOT VALUABLE
Intro to inquiry (Fire starting)					20.8	66.7	8.3	4.2
STEM careers and university information					70.8	25.0	4.2	0.0
First academic provider					62.5	20.8	12.5	4.2
Cultural Activity 1					45.8	33.3	20.8	0.0
Second academic provider					41.7	29.2	20.8	8.3
Meeting STEM professionals					79.2	12.5	8.3	0.0
Cultural Activity 2					66.7	16.7	12.5	4.2
Cultural Activity 3					45.8	33.3	16.7	4.2
Inquiry projects					58.3	25.0	12.5	4.2
Celebration dinner					75.0	12.5	8.3	4.2
Final presentations					66.7	29.2	4.2	0.0

2017–18 Summer Schools: Pre and Post Participant Responses

SECTION	QUESTION	STRONGLY AGREE OR AGREE (PER CENT)			NEUTRAL (PER CENT)			STRONGLY DISAGREE OR DISAGREE (PER CENT)		
		PRE	POST	CHANGE	PRE	POST	CHANGE	PRE	POST	CHANGE
Knowledge of STEM	I feel a strong connection between science and my Aboriginal and Torres Strait Islander culture (n = 55)	56.4	87.3	+30.9	36.4	12.7	-23.7	7.3	0.0	-7.3
	I think STEM is important for my community	89.5	98.2	+8.7	10.5	1.8	-8.7	0.0	0.0	0.0
	I have a good understanding of STEM careers	47.4	93.0	+45.6	43.9	7.0	-36.9	8.8	0.0	-8.8
Your identity	I am proud of my Aboriginal and/or Torres Strait Islander identity	94.7	100.0	+5.3	5.3	0.0	-5.3	0.0	0.0	0.0
	I am aware of practices and beliefs that are relevant to my culture (n=56)	73.2	92.9	+19.7	19.6	7.1	-12.5	7.1	0.0	-7.1
	I am involved with practices and beliefs that are relevant to my culture (n=56)	50.0	60.7	+10.7	26.8	23.2	-3.6	23.2	16.1	-7.1
	I know where to learn more about my culture	63.2	78.9	+15.7	22.8	15.8	-7.0	14.0	5.3	-8.7
	I am comfortable discussing my Aboriginal and/or Torres Strait Islander culture with others	80.7	94.7	+14.0	14.0	3.5	-10.5	5.3	1.8	-3.5
	In general, I feel safe expressing my cultural identity at school	80.7	91.2	+10.5	12.3	7.0	-5.3	7.0	1.8	-5.2

SECTION	QUESTION	STRONGLY AGREE OR AGREE (PER CENT)			NEUTRAL (PER CENT)			STRONGLY DISAGREE OR DISAGREE (PER CENT)		
		PRE	POST	CHANGE	PRE	POST	CHANGE	PRE	POST	CHANGE
About your future	I have the potential to be a role model/ mentor for young Aboriginal and Torres Strait Islander people(s)	82.5	91.2	+8.7	17.5	8.8	-8.7	0.0	0.0	0.0
	I am interested in going to university in the future	86.0	93.0	+7.0	12.3	7.0	-5.3	1.8	0.0	-1.8
	I am interested in going to TAFE in the future	31.6	33.3	+1.7	33.3	35.1	+1.8	35.1	31.6	-3.5
	I would like to work full time rather than study after leaving school	14.0	15.8	+1.8	38.6	29.8	-8.8	47.4	54.4	+7.0
	I am unsure about what I want to do in the future	15.8	19.3	+3.5	19.3	17.5	-1.8	64.9	63.2	-1.7
	I intend to study a STEM field at university	57.9	78.9	+21.0	36.8	19.3	-17.5	5.3	1.8	-3.5
	I intend to have a career in STEM	50.9	73.7	+22.8	47.4	22.8	-24.6	1.8	3.5	+1.7
	I know what a prerequisite subject is (n=56)	57.1	92.9	+35.8	8.9	3.6	-5.3	33.9	3.6	-30.3
	I know what the pre-requisite subjects are for what I want to study at university	47.4	84.2	+36.8	22.8	10.5	-12.3	29.8	5.3	-24.5
	I know how to apply to university	33.3	70.2	+36.9	33.3	19.3	-14.0	33.3	10.5	-22.8
	My family or extended family can assist me with information about university studies	73.7	78.9	+5.2	17.5	19.3	+1.8	8.8	1.8	-7.0
	I know where/how to find information about a career that interests me	82.5	93.0	+10.5	10.5	5.3	-5.2	7.0	1.8	-5.2
	I am capable of being successful at university	82.5	84.2	+1.7	15.8	12.3	-3.5	1.8	3.5	+1.7
	I think I can afford to go to university if I choose to do so (n=55)	45.5	60.0	+14.5	38.2	32.7	-5.5	16.4	7.3	-9.1
	Choosing a STEM career is more difficult than most other career options	24.6	38.6	+14.0	63.2	50.9	-12.3	12.3	10.5	-1.8

Note: Only participants who responded to both the pre- and post-surveys were included. n = 57 unless otherwise indicated.
The 'Strongly Agree' and 'Agree' categories, and 'Strongly Disagree' and 'Disagree' categories have been combined.

2017–18 Summer Schools: Pre and Post Participant Responses

SECTION	QUESTION	STRONGLY AGREE OR AGREE (PER CENT)			NEUTRAL (PER CENT)			STRONGLY DISAGREE OR DISAGREE (PER CENT)		
		PRE	POST	CHANGE	PRE	POST	CHANGE	PRE	POST	CHANGE
Knowledge of STEM	I feel a strong connection between science and my Aboriginal and Torres Strait Islander culture	54.7	92.5	+37.7	41.5	5.7	-35.8	3.8	1.9	-1.9
	I think STEM is important for my community	92.5	100.0	+7.5	5.7	0.0	-5.7	1.9	0.0	-1.9
	I have a good understanding of STEM careers	64.2	100.0	+35.8	32.1	0.0	-32.1	3.8	0.0	-3.8
Your identity	I am proud of my Aboriginal and/or Torres Strait Islander identity	100.0	98.1	-1.9	0.0	1.9	+1.9	0.0	0.0	0.0
	I am aware of practices and beliefs that are relevant to my culture	71.7	83.0	+11.3	22.6	13.2	-9.4	5.7	3.8	-1.9
	I am involved with practices and beliefs that are relevant to my culture (n = 52)	50.0	69.2	+19.2	30.8	19.2	-11.5	19.2	11.5	-7.7
	I know where to learn more about my culture	64.2	77.4	+13.2	26.4	17.0	-9.4	9.4	5.7	-3.8
	I am comfortable discussing my Aboriginal and/or Torres Strait Islander culture with others	88.7	98.1	+9.4	9.4	1.9	-7.5	1.9	0.0	-1.9
	In general, I feel safe expressing my cultural identity at school	86.8	96.2	+9.4	11.3	3.8	-7.5	1.9	0.0	-1.9

SECTION	QUESTION	STRONGLY AGREE OR AGREE (PER CENT)			NEUTRAL (PER CENT)			STRONGLY DISAGREE OR DISAGREE (PER CENT)		
		PRE	POST	CHANGE	PRE	POST	CHANGE	PRE	POST	CHANGE
About your future	I have the potential to be a role model/ mentor for young Aboriginal and Torres Strait Islander people(s)	83.0	84.9	+1.9	13.2	11.3	-1.9	3.8	3.8	0.0
	I am interested in going to university in the future	94.3	92.5	-1.9	3.8	5.7	+1.9	1.9	1.9	0.0
	I am interested in going to TAFE in the future	20.8	17.3	-3.4	50.9	57.7	+6.7	28.3	25.0	-3.3
	I would like to work full time rather than study after leaving school	15.1	9.6	-5.5	24.5	36.5	+12.0	60.4	53.8	-6.5
	I am unsure about what I want to do in the future	26.4	28.8	+2.4	26.4	23.1	-3.3	47.2	48.1	+0.9
	I intend to study a STEM field at university (n = 52)	61.5	71.2	+9.6	36.5	28.8	-7.7	1.9	0.0	-1.9
	I intend to have a career in STEM (n = 52)	55.8	71.2	+15.4	40.4	28.8	-11.5	3.8	0.0	-3.8
	I know what a prerequisite subject is	83.0	92.5	+9.4	7.5	3.8	-3.8	9.4	3.8	-5.7
	I know what the pre-requisite subjects are for what I want to study at university	64.2	80.8	+16.6	20.8	15.4	-5.4	15.1	3.8	-11.2
	I know how to apply to university	54.7	71.7	+17.0	22.6	18.9	-3.8	22.6	9.4	-13.2
	My family or extended family can assist me with information about university studies	77.4	88.7	+11.3	18.9	7.5	-11.3	3.8	3.8	0.0
	I know where/how to find information about a career that interests me	90.6	94.3	+3.8	5.7	5.7	0.0	3.8	0.0	-3.8
	I am capable of being successful at university	90.6	94.3	+3.8	9.4	5.7	-3.8	0.0	0.0	0.0
	I think I can afford to go to university if I choose to do so	56.6	64.2	+7.5	34.0	30.2	-3.8	9.4	5.7	-3.8
	Choosing a STEM career is more difficult than most other career options (n = 52)	23.1	26.9	+3.8	63.5	53.8	-9.6	13.5	19.2	+5.8

Note: Only participants who responded to both the pre- and post-surveys were included. n = 53 unless otherwise indicated.
The 'Strongly Agree' and 'Agree' categories, and 'Strongly Disagree' and 'Disagree' categories have been combined.

2016–17 Parent survey

QUESTIONS	STRONGLY AGREE (PER CENT)	AGREE (PER CENT)	NEITHER AGREE NOR DISAGREE (PER CENT)	DISAGREE (PER CENT)	STRONGLY DISAGREE (PER CENT)
My child's school respects and values Aboriginal and Torres Strait Islander culture	38.8	49.0	10.2	2.0	0.0
I feel welcome at our school	44.9	42.9	12.2	0.0	0.0
Aboriginal and Torres Strait Islander families feel that their voices are heard (represented in school decisions)	22.9	43.8	27.1	4.2	2.1
My child's school celebrates significant Aboriginal and Torres Strait Islander events	34.7	42.9	12.2	6.1	4.1
In general teachers have high expectations of my child	38.8	51.0	8.2	2.0	0.0
Generally, my child has a strong support network of peers.	36.7	46.9	16.3	0.0	0.0
Indigenous and non-Indigenous students get on well at my child's school	33.3	45.8	20.8	0.0	0.0
In the last 6 months I have been angry or upset because students have been disrespectful to Aboriginal or Torres Strait Islander people	2.2	8.7	10.9	37.0	41.3
In the last 6 months I have been angry or upset because a teacher has been disrespectful to Aboriginal or Torres Strait Islander people	4.3	8.7	13.0	32.6	41.3
You are proud of your Aboriginal and/or Torres Strait Islander identity	77.4	19.4	3.2	0.0	0.0
Your child is proud of their Aboriginal and/or Torres Strait Islander identity	51.0	46.9	2.0	0.0	0.0
You are aware of practices and beliefs that are relevant to your culture	35.5	41.9	16.1	6.5	0.0
Your child is aware of practices and beliefs that are relevant to their culture	22.4	57.1	14.3	6.1	0.0
I am comfortable discussing my Aboriginal and/or Torres Strait Islander culture with others	48.4	38.7	6.5	6.5	0.0
Your child is comfortable discussing their Aboriginal and/or Torres Strait Islander culture with others	28.6	57.1	8.2	4.1	2.0
You think your child would be better suited to university after school	41.7	39.6	14.6	4.2	0.0
You think your child would be better suited to TAFE after school	6.3	25.0	50.0	12.5	6.3
You think your child would be better suited to work after school	6.3	22.9	47.9	10.4	12.5
You know what a prerequisite subject is	28.6	55.1	6.1	10.2	0.0
You know what the prerequisite subjects are for what your child wants to study at university	20.8	47.9	14.6	14.6	2.1

QUESTIONS	STRONGLY AGREE (PER CENT)	AGREE (PER CENT)	NEITHER AGREE NOR DISAGREE (PER CENT)	DISAGREE (PER CENT)	STRONGLY DISAGREE (PER CENT)
You know how to apply to university	18.8	37.5	16.7	25.0	2.1
Your child knows how to apply for university	14.6	47.9	22.9	12.5	2.1
You can assist your child with information about university studies	16.7	35.4	29.2	18.8	0.0
You know where/how to find information about a career that interests your child	20.4	38.8	22.4	18.4	0.0
Your child is capable of being successful at university	47.9	41.7	10.4	0.0	0.0
You think your child can afford to go to university if they choose to do so	6.4	23.4	31.9	21.3	17.0
Choosing a STEM career is more difficult than most other career options	12.8	14.9	66.0	6.4	0.0
I enjoyed my school education	26.5	32.7	16.3	20.4	4.1
I enjoyed my tertiary education	21.1	63.2	13.2	2.6	0.0

Note: n = 49 unless otherwise indicated.

QUESTIONS	YES (PER CENT)	NO (PER CENT)
DEMOGRAPHIC		
I am Aboriginal	61.2	38.8
I am Torres Strait Islander	4.2	95.8
ASPECTS OF SUMMER SCHOOL		
Has your child mentioned the academic aspects of the camp?	97.6	2.4
Has your child mentioned the cultural aspects of the camp?	93.5	6.5
Has your child mentioned the personal development aspects of the camp?	87.5	12.5

EDUCATION		YES (PER CENT)	NO (PER CENT)
Have you undertaken any tertiary studies?		77.6	22.4
	YEAR 10 OR LESS (PER CENT)	YEAR 11 (PER CENT)	YEAR 12 (PER CENT)
Highest level of schooling (parent)	28.6	14.3	57.1
	TAFE CERTIFICATE (PER CENT)	UNIVERSITY DEGREE (PER CENT)	POST GRAD DEGREE (PER CENT)
Complete tertiary education (parent)	47.5	35.0	17.5

2017–18 Parent survey

QUESTIONS	STRONGLY AGREE (PER CENT)	AGREE (PER CENT)	NEITHER AGREE NOR DISAGREE (PER CENT)	DISAGREE (PER CENT)	STRONGLY DISAGREE (PER CENT)
My child's school respects and values Aboriginal and Torres Strait Islander culture	43.8	50.0	4.2	2.1	0.0
I feel welcome at our school	33.3	52.1	14.6	0.0	0.0
Aboriginal and Torres Strait Islander families feel that their voices are heard (represented in school decisions)	22.9	47.9	18.8	10.4	0.0
My child's school celebrates significant Aboriginal and Torres Strait Islander events	34.7	36.7	16.3	12.2	0.0
In general teachers have high expectations of my child	30.6	49.0	16.3	2.0	2.0
Generally, my child has a strong support network of peers.	32.7	44.9	12.2	8.2	2.0
Indigenous and non-Indigenous students get on well at my child's school	20.8	52.1	20.8	4.2	2.1
In the last 6 months I have been angry or upset because students have been disrespectful to Aboriginal or Torres Strait Islander people	4.2	14.6	22.9	41.7	16.7
In the last 6 months I have been angry or upset because a teacher has been disrespectful to Aboriginal or Torres Strait Islander people	4.2	6.3	22.9	45.8	20.8
You are proud of your Aboriginal and/or Torres Strait Islander identity	77.4	19.4	3.2	0.0	0.0
Your child is proud of their Aboriginal and/or Torres Strait Islander identity	51.0	46.9	2.0	0.0	0.0
You are aware of practices and beliefs that are relevant to your culture	35.5	41.9	16.1	6.5	0.0
Your child is aware of practices and beliefs that are relevant to their culture	22.4	57.1	14.3	6.1	0.0
I am comfortable discussing my Aboriginal and/or Torres Strait Islander culture with others	48.4	38.7	6.5	6.5	0.0
Your child is comfortable discussing their Aboriginal and/or Torres Strait Islander culture with others	28.6	57.1	8.2	4.1	2.0
You think your child would be better suited to university after school	41.7	39.6	14.6	4.2	0.0
You think your child would be better suited to TAFE after school	6.3	25.0	50.0	12.5	6.3
You think your child would be better suited to work after school	6.3	22.9	47.9	10.4	12.5
You know what a prerequisite subject is	28.6	55.1	6.1	10.2	0.0
You know what the prerequisite subjects are for what your child wants to study at university	20.8	47.9	14.6	14.6	2.1

QUESTIONS	STRONGLY AGREE (PER CENT)	AGREE (PER CENT)	NEITHER AGREE NOR DISAGREE (PER CENT)	DISAGREE (PER CENT)	STRONGLY DISAGREE (PER CENT)
You know how to apply to university	18.8	37.5	16.7	25.0	2.1
Your child knows how to apply for university	14.6	47.9	22.9	12.5	2.1
You can assist your child with information about university studies	16.7	35.4	29.2	18.8	0.0
You know where/how to find information about a career that interests your child	20.4	38.8	22.4	18.4	0.0
Your child is capable of being successful at university	47.9	41.7	10.4	0.0	0.0
You think your child can afford to go to university if they choose to do so	6.4	23.4	31.9	21.3	17.0
Choosing a STEM career is more difficult than most other career options	12.8	14.9	66.0	6.4	0.0
I enjoyed my school education	20.4	42.9	12.2	18.4	6.1
I enjoyed my tertiary education	35.5	45.2	12.9	6.5	0.0

Note: n = 49 unless otherwise indicated.

QUESTION	YES (PER CENT)	NO (PER CENT)	UNSURE (PER CENT)
DEMOGRAPHIC			
I am Aboriginal	63.8	36.2	0.0
I am Torres Strait Islander	6.7	93.3	0.0
ASPECTS OF SUMMER SCHOOL			
Has your child mentioned the academic aspects of the camp?	95.0	5.0	0.0
Has your child mentioned the cultural aspects of the camp?	93.9	6.1	0.0
Has your child mentioned the personal development aspects of the camp?	70.5	27.3	0.0

EDUCATION	YES (PER CENT)	NO (PER CENT)	UNSURE (PER CENT)
Have you undertaken any tertiary studies?	70.5	27.3	2.3
	YEAR 10 OR LESS (PER CENT)	YEAR 11 (PER CENT)	YEAR 12 (PER CENT)
Highest level of schooling (parent)	34.0	6.4	59.6
	TAFE CERTIFICATE (PER CENT)	UNIVERSITY DEGREE (PER CENT)	POST GRAD DEGREE (PER CENT)
Complete tertiary education (parent)	54.8	29.0	16.1

Year 11 Survey (2016–17 and 2017–18 Summer Schools, surveys administered in March 2017 and April 2018)

QUESTIONS	STRONGLY AGREE (PER CENT)	AGREE (PER CENT)	NEITHER AGREE NOR DISAGREE (PER CENT)	DISAGREE (PER CENT)	STRONGLY DISAGREE (PER CENT)
I feel a strong connection between science and my Aboriginal and Torres Strait Islander culture	34.5	47.3	16.4	1.8	0.0
I think STEM is important for my community	60.0	32.7	7.3	0.0	0.0
I have a good understanding of STEM careers	41.8	47.3	9.1	1.8	0.0
I am proud of my Aboriginal and/or Torres Strait Islander identity	85.5	12.7	1.8	0.0	0.0
I am aware of practices and beliefs that are relevant to my culture	30.9	47.3	14.5	5.5	1.8
I am involved with practices and beliefs that are relevant to my culture	18.2	40.0	23.6	14.5	3.6
I know where to learn more about my culture	38.2	40.0	9.1	10.9	1.8
I am comfortable discussing my Aboriginal and/or Torres Strait Islander culture with others (n=54)	66.7	18.5	9.3	5.6	0.0
In general, I feel safe expressing my cultural identity at school	61.8	29.1	3.6	3.6	1.8
I have the potential to be a role model/mentor for young Aboriginal and Torres Strait Islander people(s)	65.5	25.5	7.3	1.8	0.0
I am interested in going to university in the future	81.8	12.7	5.5	0.0	0.0
I am interested in going to TAFE in the future	5.5	23.6	40.0	16.4	14.5
I would like to work full time rather than study after leaving school (n=54)	3.7	7.4	27.8	44.4	16.7
I am unsure about what I want to do in the future	9.1	14.5	21.8	27.3	27.3
I intend to study a STEM field at university	41.8	23.6	29.1	5.5	0.0
I intend to have a career in STEM	41.8	23.6	30.9	3.6	0.0
I know what a pre-requisite subject is	63.6	27.3	3.6	3.6	1.8
I know what the pre-requisite subjects are for what I want to study at university	49.1	23.6	18.2	9.1	0.0
I know how to apply to university	30.9	36.4	12.7	18.2	1.8
My family or extended family can assist me with information about university studies	41.8	29.1	18.2	9.1	1.8
My teacher can assist me with information about university studies	60.0	32.7	7.3	0.0	0.0
My schools career advisor can assist me with information about university studies	58.2	32.7	9.1	0.0	0.0
I know where/how to find information about a career that interests me	50.9	34.5	10.9	1.8	1.8
I am capable of being successful at university (n=53)	49.1	45.3	3.8	0.0	1.9
I think I can afford to go to university if I choose to do so (n=54)	11.1	40.7	33.3	9.3	5.6
Choosing a STEM career is more difficult than most other career options	12.7	23.6	56.4	7.3	0.0

Note: n = 55 unless otherwise indicated.

Year 12 Survey (2016–17 Summer Schools, surveys administered in November 2018)

QUESTIONS	STRONGLY AGREE (PER CENT)	AGREE (PER CENT)	NEITHER AGREE NOR DISAGREE (PER CENT)	DISAGREE (PER CENT)	STRONGLY DISAGREE (PER CENT)
I feel a strong connection between science and my Aboriginal and Torres Strait Islander culture	37.5	41.7	20.8	0.0	0.0
I think STEM is important for my community	75.0	20.8	4.2	0.0	0.0
I have a good understanding of STEM careers	50.0	37.5	12.5	0.0	0.0
I am proud of my Aboriginal and/or Torres Strait Islander identity	91.7	8.3	0.0	0.0	0.0
I am aware of practices and beliefs that are relevant to my culture	37.5	50.0	12.5	0.0	0.0
I am involved with practices and beliefs that are relevant to my culture	29.2	37.5	20.8	12.5	0.0
I know where to learn more about my culture	33.3	54.2	8.3	4.2	0.0
I am comfortable discussing my Aboriginal and/or Torres Strait Islander culture with others (n=54)	70.8	25.0	4.2	0.0	0.0
In general, I feel safe expressing my cultural identity at school	66.7	25.0	8.3	0.0	0.0
I have the potential to be a role model/mentor for young Aboriginal and Torres Strait Islander people(s)	62.5	29.2	8.3	0.0	0.0
I am interested in going to university in the future	62.5	20.8	16.7	0.0	0.0
I am interested in going to TAFE in the future	20.8	12.5	37.5	20.8	8.3
I would like to work full time rather than study after leaving school (n=54)	0.0	25.0	25.0	29.2	20.8
I am unsure about what I want to do in the future	4.2	16.7	25.0	29.2	25.0
I intend to study a STEM field at university	45.8	20.8	25.0	4.2	4.2
I intend to have a career in STEM	45.8	29.2	12.5	8.3	4.2
I know what a pre-requisite subject is	83.3	12.5	4.2	0.0	0.0
I know what the pre-requisite subjects are for what I want to study at university	79.2	12.5	4.2	4.2	0.0
I know how to apply to university	66.7	25.0	0.0	4.2	4.2
My family or extended family can assist me with information about university studies	45.8	37.5	4.2	8.3	4.2
My teacher can assist me with information about university studies	70.8	25.0	4.2	0.0	0.0
My schools career advisor can assist me with information about university studies	70.8	20.8	8.3	0.0	0.0
I know where/how to find information about a career that interests me	62.5	33.3	4.2	0.0	0.0
I am capable of being successful at university (n=53)	41.7	45.8	12.5	0.0	0.0
I think I can afford to go to university if I choose to do so (n=54)	12.5	37.5	37.5	4.2	8.3
Choosing a STEM career is more difficult than most other career options (n=55)	8.3	25.0	58.3	4.2	4.2

Note: n = 24 for each question.

Destination survey (2014-15 and 2015-16 Summer School attendees; surveys administered June 2017 and April 2018)

ABOUT ME	YES	NO
I am Aboriginal	100.0	0.0
I am Torres Strait Islander	2.8	97.2
Prior to ASSETS I had been to a science camp before	23.7	76.3
After ASSETS I have been to a science camp	26.3	73.7
I have been on a university campus before	97.4	2.6
Someone in my family or extended family has been to university before	78.9	21.1
I have a parent or other role model who is working or studying in a STEM field	36.1	63.9
Why did you apply for ASSETS?	Yes	No
I was interested in the science and technology aspects of ASSETS	68.4	31.6
I was interested in the cultural and leadership aspects of ASSETS	60.5	39.5
I wanted to meet people with similar interests to mine	42.1	57.9
I thought it would help my future education	47.4	52.6
I wanted to attend a summer school away from home	28.9	71.1
Someone (e.g., teacher, friend, family member) recommended it to me	52.6	47.4
As a result of attending the ASSETS summer school, did you change your subjects for Year 11 (or 12)? (n = 34)	17.6	82.4
Have you completed Year 12? (n = 37)	91.9	8.1

Note: n= 38 unless otherwise indicated.

ATAR OR OP	90 OR MORE (PER CENT)	80 TO 90 (PER CENT)	70 TO 80 (PER CENT)	60 TO 70 (PER CENT)	50 TO 60 (PER CENT)	LESS THAN 50 (PER CENT)	NO OP (PER CENT)
If completed Year 12, please indicate whether you achieved an ATAR or OP (n=27)	7.4	14.8	25.9	22.2	7.4	3.7	18.5

Note: In the original survey, the score categories overlapped (e.g., a score of 80 could be in two categories). This has been resolved in subsequent surveys.

DESTINATION	UNIVERSITY (PER CENT)	TAFE (PER CENT)	EMPLOYED (PER CENT)	GAP YEAR (PER CENT)
What are you doing now? (n=38)	71.1	7.9	18.4	2.6

WHAT ARE YOU STUDYING AT UNIVERSITY? (N=27)	YES	NO
Science	29.6	70.4
Technology	11.1	88.9
Engineering	7.4	92.6
Maths	7.4	92.6
Medicine	0.0	100.0

ABOUT MY TIME AT SCHOOL	STRONGLY AGREE (PER CENT)	AGREE (PER CENT)	NEITHER AGREE NOR DISAGREE (PER CENT)	DISAGREE (PER CENT)	STRONGLY DISAGREE (PER CENT)
My school respected and valued Aboriginal and Torres Strait Islander culture	47.4	28.9	18.4	0.0	5.3
Aboriginal and Torres Strait Islander families feel welcome at my school	34.2	36.8	18.4	5.3	5.3
Aboriginal and Torres Strait Islander families feel that their voices are heard (represented in school decisions)	15.8	36.8	31.6	10.5	5.3
My school had a good relationship with my family	26.3	47.4	21.1	0.0	5.3
I learnt about my culture in most subjects	0.0	18.4	23.7	36.8	21.1
My school celebrated significant Aboriginal and Torres Strait Islander events	31.6	44.7	15.8	7.9	0.0
I felt a strong connection between science and my Aboriginal culture	2.6	31.6	42.1	18.4	5.3
I had a strong support network of peers	39.5	39.5	15.8	5.3	0.0
I had a strong support network of peers who shared my interest in STEM	13.2	44.7	23.7	13.2	5.3
I was proud of my Aboriginal and/or Torres Strait Islander	71.1	18.4	7.9	2.6	0.0

Note: n = 38 for all questions.

	LIFE CHANGING (PER CENT)	A LOT (PER CENT)	A LITTLE (PER CENT)
Reflecting on the impact of ASSETS, how significant an influence do you think it has had on your study and career directions? (n=38)	28.9	52.6	18.4

Appendix F

Review of evidence

This section provides a brief overview of relevant evidence for each outcome covered in this case study report.

1 High aspiration for a STEM career (and STEM subject selection)

Career (and educational) aspirations are influenced by a range of social factors and individuals' local environment (Prodonovich, Perry, & Taggart, 2014). In addition, some researchers note cross-cultural differences in 'aspirations', with Western views of aspirations typically linked to self-fulfilment and freedom, while these may not necessarily be prioritised by other cultures, as demonstrated by the wide spectrum of aspirations of Indigenous Australians (Bulloch & Fogarty, 2016; Walker, 2006). Location and distance from educational and employment opportunities also impact students' aspirations. Students in urban areas more often see people in a wide range of occupations and are likely to have many student peers aiming for university and professional careers. Students in rural and remote locations have less exposure to these opportunities, which can limit their education and occupational aspirations (Parker, Jerrim, Anders, & Astell-Burt, 2016; Wilson, 2013). The distance from a university has been found to exert a unique influence on student aspirations over-and-above socioeconomic status and academic ability (Parker et al., 2016). There are also gender differences in STEM career aspirations, with young women less likely to aspire to STEM careers even when actual academic performance does not differ (Watt et al., 2017).

In terms of Aboriginal and Torres Strait Islander students' aspirations, there is evidence that education and support systems are not effectively helping students to: discern the specific relevance of school subjects as a foundation to achieving career aspirations (Craven et al., 2005); aspire to participate in higher education (Behrendt, Larkin, Griew, & Kelly, 2012; Gore et al., 2017); or establish occupational certainty (Sikora, 2018). However, many Aboriginal and Torres Strait Islander students have similar occupational aspirations compared to their non-Indigenous peers (Gore et al., 2017). Critical success factors for supporting aspirations of Aboriginal and Torres Strait Islander students include: early intervention to influence subject choice; wide promotion of professional pathways; presentations of positive images of Aboriginal and Torres Strait Islander students; authentic involvement of families and key community members in building aspirations; innovative and engaging curriculum and pedagogy for young people that is connected to their lived experience; strong peer support networks; and efforts to increase the desirability of higher education (Behrendt et al., 2012; Gore et al., 2017; Parkinson & Jones, 2018).

2 Better understanding of, and confidence in pursuing, STEM career pathways

Many Aboriginal and Torres Strait Islander students have been incorrectly taught negative views of their academic abilities and, as a result, lack confidence (Behrendt et al., 2012). Fifteen-year-old Aboriginal and Torres Strait Islander students are significantly less likely to feel confident at school than their non-Indigenous counterparts, although these differences are substantially reduced or reversed when other demographic and geographic factors are controlled for (Biddle & Cameron, 2012). Many Aboriginal and Torres Strait Islander students have a very early career focus but lack the career support to enact that focus (Day & Nolde, 2009).

Several confidence-building factors and actions have been identified to support STEM career attainment. Career confidence in a specific field can be enhanced through academic achievement in subjects relevant to that field (McKenzie, Coldwell-Neilson, & Palmer, 2018). For example, obtaining high grades in mathematics provides greater confidence to pursue a career in that subject. Self-confidence to achieve education and career aspirations requires explicit descriptions of possible pathways and futures, rather than generalities (Carroll, 2014); and is assisted through the encouragement of peers, teachers, and parents (Hassan, 2011). Career intentions, including those in STEM, are developed early, so it is important to help build confidence early in students' lives (Fitzsimmons, Yates, & Callan, 2018). Finally, the integration of Indigenous perspectives, language, and culture into school curricula, education activities, and support programs have been shown to increase student self-confidence and motivation both in Australian and other contexts (Crombie et al., 2003; Douglas, 2011; Hall, 2015; Kanu, 2005).

3 Greater confidence in cultural identity and the relevance of culture for a STEM career

Cultural identity has been framed as central to the social and emotional wellbeing of Aboriginal and Torres Strait Islander peoples (Hopkins, Zubrick, & Taylor, 2014). Stronger attachment to traditional culture is associated with enhanced outcomes across several socio-economic dimensions, including educational attainment and meaningful employment (Dockery, 2010). Importantly, nurturing cultural identity is a key factor in supporting young Aboriginal and Torres Strait Islander people to remain engaged in education (Shay & Wickes, 2017). When applied to navigating educational contexts and setting goals, Indigenous identity can be an important source of resilience and strength for students (Hall et al., 2015). However, embedding cultural identity in educational contexts is difficult, and requires from educators and students ongoing commitment to self-analysis, reflection, and willingness to embrace uncertainty (Miller, 2018). There are some differences between the cultural identity of Indigenous Australians living in remote areas to those in non-remote areas, with participation in cultural events, ceremonies, or organisations and identification with a clan, tribal or language group more prevalent in remote areas (Cunningham & Paradies, 2012). Successful STEM enrichment programs consider socio-cultural factors, such as students' cultural and family backgrounds, academic histories, and previous exposure to STEM, and in general, consider the student first, rather than focusing on content knowledge (Lowrie, Downes, & Leonard, 2017).

Cultural identity, in terms of careers and the workplace, is central for some people (Burgess, 2012) and plays a particularly important role in shaping the career decisions of Aboriginal and Torres Strait Islander people (Helme, 2010). Generally, Aboriginal and Torres Strait Islander people are under-represented in STEM careers, which may be due to a common myth that science and engineering are purely Western constructs (Ball, 2015). Another factor is the lack of role models or support to assist them transition to new employment in STEM fields (Burgess & Dyer, 2009), due, in part, to the paucity of Aboriginal and Torres Strait Islander students undertaking science degrees (McLisky & Day, 2004). In addition, many Aboriginal and Torres Strait Islander people place more importance on kinship and relatedness, than the Western norms that place employment as central to identity (McRae-Williams & Gerritsen, 2010). For example, in one study only approximately half of Aboriginal and Torres Strait Islander professionals and managers felt their workplace allowed their cultural obligations to be met (Taylor, Gray, Hunter, Yap, & Lahn, 2012). Culture plays an important role in the pathway to, and fulfilment in, a STEM career.

4 Growth in student and professional networks

In a school context, perceptions of peer relationships are important for affective school engagement (Dunstan, Hewitt, & Tomaszewski, 2017). Peer support is also positively associated with behavioural and cognitive engagement (Lam et al., 2014), school belonging (Allen, Vella-Brodrick, & Waters, 2016). Similarly, student peer networks are important support structures to overcome isolation and assist completion of a university degree (Barney, 2018; Gallop & Bastien, 2016) and these support services are more likely to be used if students' trusted networks suggest they do so (White, 2016). Expanded student social networks contribute to a young person's social capital and provide greater opportunities for support of personal and academic decision making, wellbeing, and growth (Pendergast et al., 2018).

Upward social mobility (driven, for example, by pursuing a STEM career) requires the establishment of new networks of social and professional relationships, which may be challenging for some Aboriginal and Torres Strait Islander people whose existing social networks are based on kinship, or who may have been excluded from advantageous networks of power and privilege (Walter, 2015). This notion is supported by various government policies and strategies, that acknowledge the importance of developing and growing professional networks to support the career development and employability of Aboriginal and Torres Strait Islander peoples (Australian Government, 2015; NSW Government, 2014; PWC, 2013; Victorian Government, 2016).

5 Increased community and parental engagement

As children grow into adolescence, families and communities, and the cultural attributes of their surrounds, can have a significant influence on young peoples' educational decision-making and post-secondary pathways (Best, MacGregor, & Price 2017; McInerney, Smyth, & Down, 2011; Skene, 2010). Students in Years 10 to 12 are developmentally in a stage of significant physical, social, emotional, and cognitive change, often associated with increased rates of disengagement from school (Pridham & Deed, 2012). For Aboriginal and Torres Strait Islander young people, positive adult connections in education and a focus on community relationships can either promote wellbeing or protect against risk factors associated with disengagement (Andersen, Edwards, & Wolfe, 2016). Effective and positive engagement by parents and members of their Aboriginal and Torres Strait Islander and non-Indigenous communities is characterised by authenticity; respect of others' world views; accessibility; and purposeful connection to education opportunities and a real-world career (Broadbent & Cacciatollo, 2013; Donovan, 2018; Pridham & Deed, 2012). However, parental engagement needs to take into account the diversity of capacities and resources that families possess (Blackmore & Hutchison, 2010); and the perception of shared values between the education environment and the home (Bissett, 2013).

Historically, Indigenous knowledge (including scientific knowledge) has often been depicted as inferior to Western knowledge, or has even been dismissed altogether (Ewing, 2014; Martin, Nakata, Nakata, & Day, 2015). Underlying the relationship between the mainstream education system and Aboriginal people is a colonial history of exclusion and systemic disadvantage (Lowe, 2017). Therefore, a diverse workforce or the capability of educators to be culturally responsive is important to change this view and increase educational engagement with Aboriginal and/or Torres Strait Islander families and community members (Ewing, 2014; Shay & Wickes, 2017). Models of education that value engagement and partnerships between students, parents, and the broader community benefit from the often relational nature of Aboriginal and Torres Strait Islander cultures; and can draw on the shared practices, ways of knowing, and language of some communities (Donovan, 2015). Authentic engagement between Aboriginal and Torres Strait Islander people and educators can also positively impact professional knowledge and develop pedagogic practices that are culturally responsive (Lowe, 2017). Models of education that support increased family and community involvement in the education of Aboriginal and Torres Strait Islander students include: family and community based events; encouraging representation at all levels of education; forming community partnership programs; and involving community members in learning events and activities (such as 'on-country' two-way science and inviting influential cultural leaders to participate in or lead culturally inclusive activities) (Allen et al., 2016; Douglas, 2011; Pridham & Deed, 2012). Finally, the OECD has identified 'engaging families' as the lowest-cost and highest impact school-level priority to boost the education outcomes for Indigenous students (OECD, 2017).

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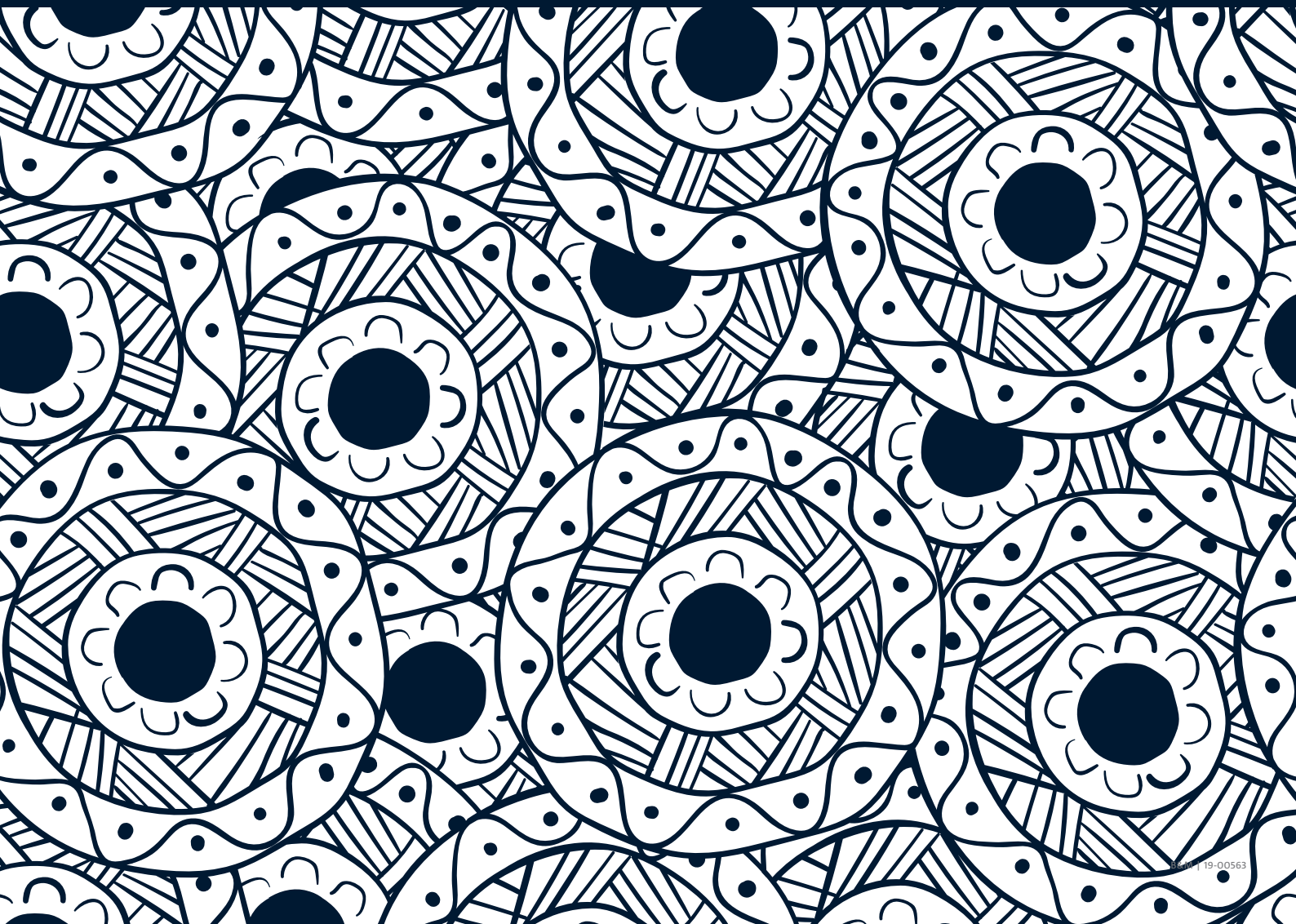

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