Australian Government

Additional diversity in STEM program reviews report

# Additional diversity in STEM program reviews

# Contents

**Pathway to Diversity in STEM Review** ..... **1**
**Additional diversity in STEM program reviews** ..... **1**
**Purpose and overview** ..... **5**
Programs included ..... 5
Key findings ..... 6
**Curious Minds** ..... **7**
Key lessons ..... 7
Program summary ..... 8
Program delivery and funding ..... 8
Evaluation and findings ..... 10
Conclusion ..... 13
**Indigenous STEM Education Project** ..... **14**
Key lessons ..... 14
Program summary ..... 15
Program delivery and funding ..... 15
Evaluation and findings ..... 16
Conclusion ..... 20
**Indigenous Girls' STEM Academy** ..... **22**
Key lessons ..... 22
Program summary ..... 23
Program delivery and funding ..... 24
Evaluation and findings ..... 31
Conclusion ..... 31
**RLabs** ..... **32**
Key lessons ..... 32
Program summary ..... 32
Program delivery ..... 34
Evaluation and findings ..... 35
Conclusion ..... 36

**Maths Multiplies Your Choices ..... 37**
Key lessons ..... 37
Program summary ..... 38
Program delivery and funding ..... 38
Evaluation and findings ..... 39
Conclusion ..... 42
**Appendices ..... 43**
**Indigenous STEM Education Project evaluation summaries ..... 43**
Appendix A: Aboriginal Summer School for Excellence in Technology and Science (ASSETS) ..... 44
Appendix B: Bachelor of Science (Extended) ..... 45
Appendix C: Indigenous STEM Awards ..... 48
Appendix D: $I^2S^2$ ..... 49
Appendix E: Science Pathways for Indigenous Communities ..... 51
Appendix F: Purposeful Rich Indigenous Mathematics Education (PRIME Futures) ..... 53

# Purpose and overview

The terms of reference for the **Pathway to Diversity in STEM Review** provided scope for the independent panel to consider other evidence-based information, including from other diversity in STEM initiatives relevant to the review.

The reviews within this report explore lessons from different programs to identify successful and less successful program elements to support underrepresented cohorts to engage in STEM education and careers. The reviews were largely informed by publicly available information and evaluation material.

The reviews aim to provide additional insights to those gained from the ACIL Allen evaluation of the suite of 9 women in STEM programs that are (or were) administered by the Australian Government's Department of Industry, Science and Resources. Those programs predominantly focus on women, either in education or the workforce.

## Programs included

The programs included in this review are:

- Curious Minds
- Indigenous STEM Education Project
- Indigenous Girls' STEM Academy
- RLabs
- Maths Multiplies Your Choices.

These programs were chosen because they provide:

- support for diverse or intersectional cohorts
- a variety of delivery mechanisms
- data, information, and evaluations.

# Key findings

The key findings from these reviews include:

- longer-term commitment and funding of initiatives is needed to support people across the whole STEM pathway
- ongoing monitoring and evaluation, from design phase through the program lifecycle, is needed to ensure programs are fit-for-purpose
- better data collection and capture of long-term outcomes is needed (such as retention and career progression), to inform investment in programs that work
- initiatives that are community-led and/or are designed in collaboration with the communities and people they aim to support, lead to greater engagement and likely success
- a range of flexible forms of support, that consider local circumstances, are needed to address individual barriers and needs. For example, supporting teachers and parents to build relationships between community, schools and industry will require different support structures for different communities and schools.

# Curious Minds

The Curious Minds program is an example of **a school-industry engagement program** that provides the opportunity for female STEM professionals to mentor female school students. The program engages Year 9 and 10 female students and STEM mentors in a 6-month STEM extension program (including camps, mentoring, and networking).

## Key lessons

- The Curious Minds program gives priority to students that have limited opportunities[1] to engage with STEM, which increases the opportunities for these students to engage with STEM. However, all students are required to apply for the program, and there is an expectation that participants will complete the program in addition to their schooling and personal commitments.
- There is a cost to participate in the program ($200). While there is the option to apply for an exemption, the student is required to request this and is subject to approval by the program organisers.
- The participation cost, administrative processes, and expectations of participants in the program could act as unintended barriers for students to apply and participate, which runs counter to the program's purpose of increasing participation.
- Program organisers can deliver the program in-person or virtually, allowing for greater potential to allow regional/remote students and mentors to participate in the program. Program organisers successfully delivered a virtual model of the program during COVID-19. The current program cycle (2023-2024) will deliver the program using a hybrid model (combination of virtual and in-person events) due to the additional costs associated with providing a full in-person camp as part of the program.[2, 3]

[1] Limited opportunities are: students from regional/rural/remote areas, students from schools with an Index of Community Socio-Educational Advantage (ICSEA) of less than 1000, or students that have an Aboriginal or Torres Strait Island background.

[2] *Curious Minds: STEM schools for girls project plan 2022-2023*, from the delivery partners (AMT and ASI).

[3] *Curious Minds evaluation report*, 2021-2022, from the delivery partners (AMT and ASI).

# Program summary

Curious Minds engages Year 9 and 10 female students and STEM mentors in a 6-month STEM extension program, which comprises of a:

- camp program: two camps in a 6-month period where students get the opportunity to meet like-minded students and learn about STEM
- mentoring program: students are partnered with a volunteer female STEM mentor for six months, who mentor their student to complete a STEM project.

From 2021, the Connect Program was added to the Curious Minds program schedule. The Connect Program is a series of additional content, workshops, and social events to promote student interaction and engagement between the 2 camps. For the 2021-2022 program cycle, the Connect Program consisted of 10 events, delivered bi-monthly. This included Olympiad tutorials, student goal setting session, guest speaker presentations and a science communication workshop.

Program participants also receive free registration to the Australian Science Olympiad Exams and are encouraged to participate throughout the Curious Minds program.

The purpose of the program is to:

- build confidence, interest, and skills in STEM in Year 9 and 10 girl students who have had limited opportunities to engage with STEM by participating in a 6-month extension and mentoring program.
- provide an opportunity for women professionals working in a STEM field to mentor Year 9 and 10 students in the program. Volunteering as a mentor can further develop teaching and mentoring skills, inspire students to pursue studies and/or a career in STEM, and create networks with other women STEM professionals.

# Program delivery and funding

- The program is jointly delivered by Australian Maths Trust (AMT) and Australian Science Innovations (ASI).
- The current university partners are the Australian National University (ANU) and the University of Adelaide (UoA).
- Between 2015-2021, 421 students participated in the program (see Figure 1).
- Funding provided by the Australian Government includes:
  - 2014-15 ($205,000) through the Office for Women, Department of the Prime Minister and Cabinet
  - 2015-16 to 2016-17 ($600,000) under the Restoring the Focus on STEM initiative, through the Department of Education

- 2018-19 to 2019-20 ($640,000) under the NISA Inspiring all Australians in Digital Literacy and STEM initiative, through the Department of Education
- 2020-2021 to 2023-2024 ($2.35 million) to continue and expand the program under the Women's Economic Security Package.[4] These funds are administered by the Department of Education.

- In 2022 and 2023, 3M was an industry sponsor and provided additional funding of $43,980 ($30,500 USD) to the program through the Global Giving grant program. The funds included provision of diversity training by 3M staff to students and coaches, as well as the opportunity for 3M staff to volunteer as coaches.

## Selection criteria

To participate in the Curious Minds program, there are selection criteria and an application process that applies for both prospective students and STEM professionals. These criteria are set out in Table 1.

*Table 1: Selection criteria and application process for the Curious Minds program*

| For students | For STEM professionals |
|---|---|
| In recent program cycles, the delivery partner has used the following strategy to promote and recruit potential students to the Curious Minds program.<br>• A recruitment drive to identify students and ask them to submit an expression of interest via the website when applications open. Students can be identified through:<br>- online student information session promoting the program<br>- high performers from the following events:<br>- ASI events, such as The Big Science Competition<br>- AMT events Computation and Algorithmic Thinking competition and The Australian Maths Competition<br>- public expressions of interest via the website can also be accepted (through the Curious Minds website). | • STEM professionals can participate in the program as a mentor by first submitting an expression of interest through the Curious Minds website. A recruitment drive for mentors runs concurrently with the student recruitment process.<br>• Prerequisites for STEM mentors are listed below:<br>- proven interest in STEM activities<br>- the desire and capability to work with young people, in particular high school students<br>- an understanding of, and agreement to, mentoring responsibilities<br>- a completed Working with Children Check (or state equivalent)<br>- the ability to commit to time requirements (complete mentor training, meet regularly with student, attend a wrap-up session during the July camp). |

[4] https://www.education.gov.au/australian-curriculum/support-science-technology-engineering-and-mathematics-stem

| For students | For STEM professionals |
| --- | --- |
| • After expressions of interest are reviewed, a shortlist of students is generated. Priority is given to students from rural and remote locations, schools with lower ICSEA values and students from Indigenous backgrounds.<br><br>• Students on the shortlist are then invited to submit their application forms via an online portal.<br><br>• Students then need to submit their application form before the close date. As part of the application process, students need to submit a teacher referral form and a copy of their latest school report.<br><br>• Applications are assessed and successful applicants are notified. | |

# Evaluation and findings

There are no publicly available evaluation materials that cover the lifespan of the Curious Minds program since its inception in 2015. This makes it challenging to gauge the impact of the program over time and if has been a driver of long-term behavioural change from its participants. However, the program was included in the *Evaluation of early learning and schools initiatives in the National Innovation and Science Agenda* in 2020. Key findings are included below.

In addition, an evaluation framework was developed in the initial program inception phase in 2015 which has informed annual internal evaluation reports delivered by the program managers to the Department of Education. A summary of the 2021-2022 cycle findings is provided below (noting the 2022-2023 evaluation report is currently being finalised) along with an infographic with high-level program outcomes data from 2015-2021.

The Australian Government is now funding an independent program evaluation, which will be completed by mid-2024.

Data previously provided by the program managers indicated that of those girls who participated between 2014-2019, 94% went on to study STEM in Years 11 and 12, and then on to university (or had taken a gap year followed by university). Additionally, 78% of participants said they intended to pursue a STEM career.

## Curious Minds internal evaluation

Internal monitoring evaluation covers the 2021-2022 program cycle and is from the delivery partners AMT and ASI (i.e. self-evaluation). The 2021-2022 program was delivered virtually. It comments on the following aspects of the 2021-2022 program cycle:

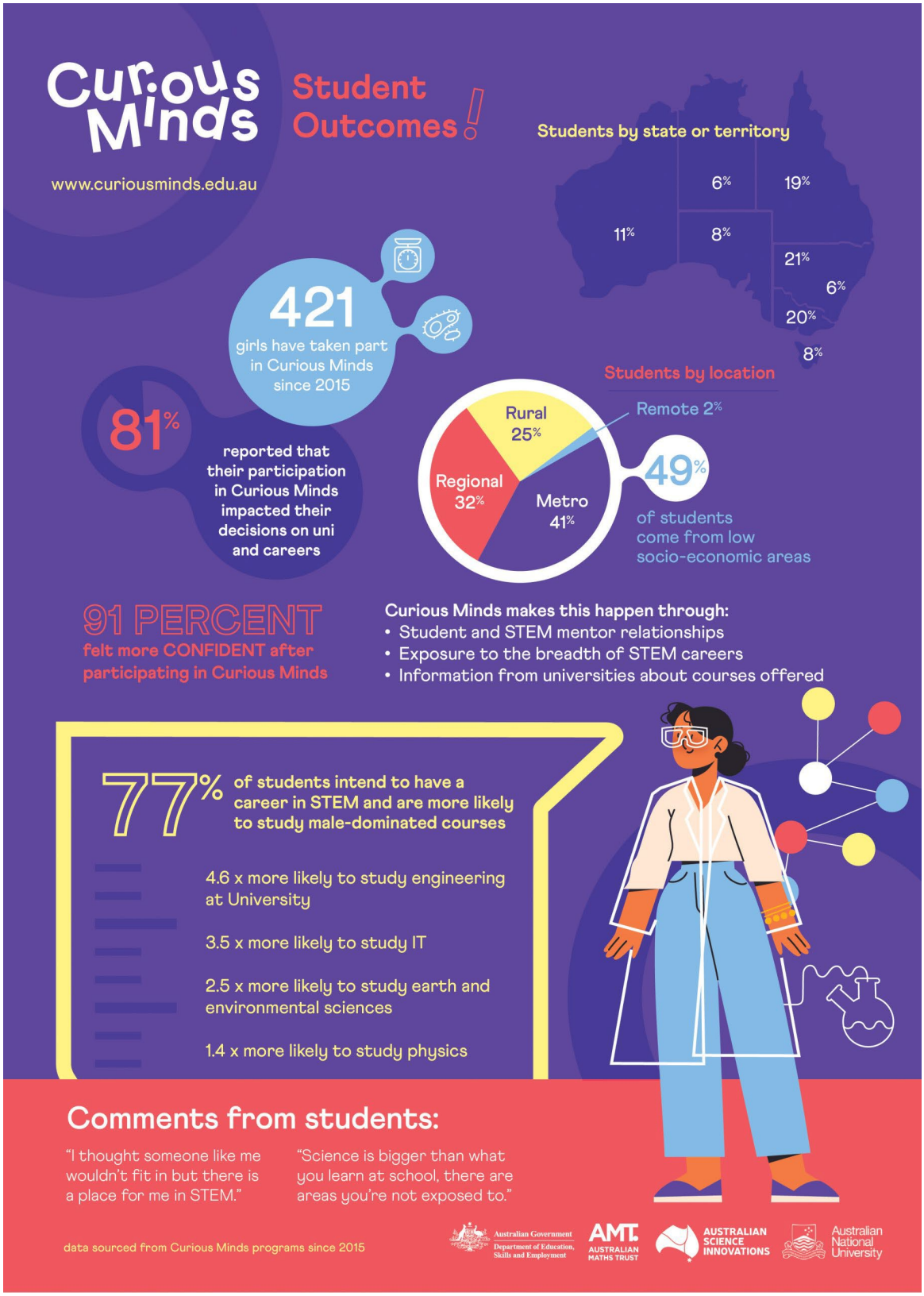
- program deliverables (camps, Connect Program, mentoring)
- participant feedback (students and mentors) throughout the program cycle
- overview of application process - for the 2021-2022 program, 133 expressions of interest were received for the program after the recruitment campaign. After review, all expressions of interest that were submitted were invited to apply through the student portal. 111 applications were submitted, and they were all accepted in the program.[5]
- student contribution fee breakdown
- Curious Minds student participation in the Science, Maths and Informatics Olympiad programs
- budget review.

Key findings and feedback from self-reported evaluation data the evaluation include[5]:

- the 2021-2022 program was delivered virtually due to the continual disruption of COVID-19
- students found the mentoring aspect of the program valuable (96% of students from the 2021-2022 program cycle). Students used the opportunity to discuss university and career options in STEM
- mentors would recommend being a mentor to their colleagues and peers (95% of mentors from the 2021-2022 program cycle) and had the opportunity to build their mentoring skills
- the next program cycle (2022-2023) was also delivered as a hybrid model (summer camp was virtual, winter camp was face to face) due to relaxation of COVID-19 restrictions and budget constraints.

[5] *Curious Minds evaluation report*, 2021-2022, from the delivery partners (AMT and ASI).

*Figure 1: Curious Minds program outcomes infographic (2015-2021)*[6]




[6] https://curiousminds.edu.au/student-outcomes-infographic/

## Evaluation of the early learning and schools initiatives in the National Innovation and Science Agenda (NISA)

- An evaluation of the early learning and schools initiatives that were funded through the NISA was carried out by dandolopartners. While it considers these NISA funded programs[7] as a suite, there is also a brief evaluation of the Curious Minds program (2018-2019 cycle).
- Key findings of interest to the review include:
  - the program has a reputation of addressing the issue of under representation of women in STEM by inspiring female secondary students to consider further STEM education and pursue a STEM career
  - *'Some stakeholders are familiar with Curious Minds due to its objectives addressing gender diversity, and the initiative has positive brand recognition in this* regard*. It's considered as a useful 'feeder' program to create a pipeline of girls into STEM.'*
  - the evaluation noted that there are many STEM engagement programs that target students, but not necessarily strengthening teacher capability to improve STEM engagement
  - *'Initiative findings for Curious Minds also suggest positive outcomes for students, including an increased likelihood of students pursuing STEM subjects in later years. However, there are reservations about the initiative's scope and its direct student focus rather than strengthening teacher capability.'*
- The following resources were used in the evaluation:
  - progress report from the delivery partners (AMT and ASI) for the period 1 August 2018 to 31 January 2019
  - interview with the delivery partner
  - Curious Minds infographic for 2015-2019.

# Conclusion

The Curious Minds program has successfully raised awareness of and encouraged underrepresented students to explore and pursue STEM studies and careers. The mentorship aspect of the program is quite popular with participants as well. Unfortunately, there is limited longitudinal data available that could be used to determine the take up of STEM tertiary studies attributable to the program. The upcoming independent program evaluation will seek to investigate this, as well as to inform future program design, delivery decisions and policy directions.

[7] NISA provided funds for 15 STEM education (early years and schools) initiatives in the education portfolio.

# Indigenous STEM Education Project

The Indigenous STEM Education Project was a suite of 6 sub-programs aimed at **increasing interest and academic achievement** in STEM subjects and professions among Aboriginal and/or Torres Strait Islander students and building educator capability and cultural competence. It also aimed to promote the value of unique Aboriginal and Torres Strait Islander cultures, customs, scientific knowledges and languages, and foster relationships between schools and communities.

## Key lessons

- Systemically changing the way STEM education is designed and delivered to increase engagement by First Nations students requires a centralised strategy and localised implementation planning and support. This includes engagement with schools and governments to promote curriculum and policy change. This type of work was limited during the life of the project due to resourcing constraints, highlighting the need for dedicated bottom-up and top-down approaches to influence systemic change.
- Building in an evaluation framework from the outset of programs helps to measure success. Further attention should be given to longer-term measurement of how programs influence student subject and career choice, and ensuring projects are implemented over the long-term to influence change.
- STEM curriculum resources and teaching approaches that draw on Aboriginal and Torres Strait Islander knowledges should be developed and implemented through partnerships with the local community, including Elders, Traditional Owners and local knowledge custodians.
- Teachers need time and accessible resources to understand and feel confident to teach using Aboriginal and Torres Strait Islander knowledges as a context for STEM education.
- The importance of the influence of systemic barriers on program success. The project identified common barriers to success across programs relate to barriers to equity, access, and increasing diversity.

# Program summary

Operating from 2014-2021, The Indigenous STEM Education Project was a partnership between the CSIRO and the BHP Foundation to show how different approaches to STEM education could increase engagement and adoption in primary/high school and higher education settings. It included six sub-programs detailed below. Read more detail on each program and the CSIRO evaluation in the Appendices.

*Table 2: Indigenous STEM Education Project sub-program focus*

| | |
|---|---|
| **Aboriginal Summer School for Excellence in Technology and Science (ASSETS)** | Engaging high-achieving Year 10 First Nations students in STEM through camps and networking.<br><br>See Appendix A. |
| **Bachelor of Science (Extended)** | Supporting First Nations students to complete a Bachelor of Science degree at Melbourne University.<br><br>See Appendix B. |
| **Indigenous STEM Awards** | Celebrating and increasing visibility of achievements of First Nations people in STEM.<br><br>See Appendix C. |
| **Inquiry for Indigenous Science Students ($I^2S^2$)** | Building teacher capability in culturally responsive teaching approaches in inquiry learning.<br><br>See Appendix D. |
| **Science Pathways for Indigenous Communities** | On Country inquiry-based learning (i.e. two-way science, that connects cultural knowledge with Western science) in remote areas to improve STEM learning and teacher capability.<br><br>See Appendix E. |
| **Purposeful Rich Indigenous Mathematics Education (PRIME Futures)** | Building teacher capability in teaching maths to First Nations students, encouraging student engagement.<br><br>See Appendix F. |

# Program delivery and funding

The BHP Foundation pledged $28.8 million seed funding for the CSIRO to implement the project from 2014-2021. This was the sole funding source for the project.

The delivery method varied across sub-programs. The overarching project was run by the CSIRO, and project teams ran sub-programs such as ASSETS, $I^2S^2$, Science Pathways for Indigenous Communities, and the Indigenous STEM Awards. CSIRO partnered with the Queensland University of Technology to deliver PRIME Futures, and the University of Melbourne to deliver the Bachelor of Science (Extended).

Although the project has ceased, successful elements have been implemented in subsequent programs or initiatives (such as, Young Indigenous Women's STEM Academy, Generation STEM, Living STEM and STEM Together). For example:

- the Western Australian Government is delivering a two-way science initiative (combining western and Indigenous scientific knowledges), using the program model and resources from the Science Pathways for Indigenous Communities program (through a partnership agreement with CSIRO)
- the online educator professional learning portion of $I^2S^2$ is being delivered in schools participating in the current Living STEM program (partnership between CSIRO and Chevron)
- elements of ASSETS, including camps, networking, work placements, and supporting work experience during tertiary education, have been implemented as part of the Young Indigenous Women's STEM Academy.

# Evaluation and findings

A 2021 CSIRO self-evaluation of the project found it to be effective overall. Achievement of desired outcomes varied across sub-programs and program elements. Programs were generally more successful at measuring and achieving shorter-term outcomes (e.g. awareness and engagement of Indigenous and non-Indigenous students in inquiry-based learning, two-way science and STEM careers, teacher confidence in inquiry-based learning and two-way science). Longer-term impacts were, as expected, more difficult to measure and directly attribute to programs, such as students progressing through STEM pathways.

## Program highlights

A strengths-based approach to monitoring and evaluation was undertaken by CSIRO throughout the project lifespan. This included focusing on 'what works' while acknowledging challenges and listening to Aboriginal and Torres Strait Islander peoples as part of iterative program improvement. The approach to evaluation itself is a valuable lesson to take from the project, in making iterative adjustments to programs to ensure they are effective and fit for purpose.

A total of 4 CSIRO-led evaluation reports culminated in a final report that rated progress towards outcomes on a scale of 'Transformative', 'Effective' or 'Emerging'. CSIRO researchers evaluated sub-programs as being 'Effective' overall in meeting their desired outcomes.

All sub-programs were assessed as having a high level of evidence of one or more 'Transformative' outcomes, resulting in substantial, widespread positive impacts for participants.[8] Table 3 highlights some of these impacts.

While the Indigenous STEM Awards was not subject to a full evaluation, the final report highlighted the value of recognising, celebrating, and increasing visibility of the achievements of Aboriginal and Torres Strait Islander people studying and working in STEM. For example, 94% of surveyed recipients agreed that their award contributed to recognition of their achievements by their community, and 92% felt more connected to a community of Aboriginal and Torres Strait Islander people in STEM.

*Table 3: Indigenous STEM Education Project transformative outcomes*

| Transformative outcomes | Elements contributing to success |
|---|---|
| **Increased student awareness, engagement, results, and recognition**<br><br>*41.5% of Aboriginal and Torres Strait Islander students in the $I^2S^2$ program had increased engagement in science.*[9] | • Improved teacher understanding and confidence in delivering two-way science and Indigenous inquiry-based learning approaches.<br>• Hands-on, inquiry-based, and culturally responsive STEM education approaches benefited the engagement of both Indigenous and non-Indigenous students in classes taught by teachers participating in the programs.<br>• Exposure and visibility of STEM career opportunities, such as work placements, mentors, alumni networks. |
| **Implementation of place-based Indigenous-led or contextualised STEM curriculum in schools, and increased teacher capacity to deliver it**<br><br>*85% of teachers in the Science Pathways said the program increased their ability to teach two-way science.* | • 'Train-the-trainer' models and professional development workshops to disseminate knowledge and build teacher capacity/confidence.<br>• Influencing school leadership to buy-in to new approaches.<br>• Supporting strong partnerships between schools and their local communities. |
| **Strengthened engagement with parents, families, and communities**<br><br>*81% of respondents said the Science Pathways program increased their ability to collaborate with the Indigenous community to teach two-way science.* | • Schools and teachers valuing community input to develop STEM curriculum, and prioritising the experience and knowledge of Elders, Traditional Owners, and regular on-country trips.<br>• Creation of a welcoming and safe environment for families and communities to partner in student learning. |

[8] CSIRO, *Indigenous STEM education project: final evaluation report*, p17. 'Effective' = the outcome was mostly or fully achieved and there was evidence of positive shifts. 'Emerging' = the outcomes as showing early signs of achievement, and evidence of positive shifts beginning to be developed.

[9] Note: this increase was for students defined as having prior 'low-achievement' of grades D or E prior to participating in the program.

Studies have also highlighted the benefits of integrating Aboriginal and Torres Strait Islander knowledges with Western knowledge to achieve successful and innovative learning outcomes for both Indigenous and non-Indigenous students.[10,11] This is reinforced where Aboriginal and Torres Strait Islander people are an integral part of implementation and continual development of school curricula, and education policies.[12]

## Key lessons and considerations

The CSIRO evaluation highlighted some important lessons learned across projects, which may be useful to consider as part of the review.

### Measuring student outcomes

The project faced common difficulties in measuring program impact on longer-term retention in STEM career pathways once students transitioned out of the program. For example, the Bachelor of Science (Extended) program has retention data for cohorts while they are studying, but data was not available to understand their journey into a career or further education:

- the retention rate for all program cohorts from 2015 to 2019 (75%, 86%, 95%, 79% respectively) was comparable to the retention rate of 71.2% for all Aboriginal and Torres Strait Islander Bachelor students in Australia in 2017[13]
- 17% of students had transferred to another course at the University of Melbourne, however, data was not available to determine pathways of other students who exited the program
- the small sample size for the Bachelor of Science (Extended) program makes it difficult to draw strong conclusions on retention.

The evaluation recommends that programs should be student-centric in how student success is defined (e.g. transferring to other courses should still be seen as an individual success in terms of broader educational outcomes). However, it is important to capture any external barriers to students progressing in STEM related courses.

Programs should also be realistic about the expected pace of change, noting the varied factors that influence outcomes and choices for all students.

[10] P Joyce and K Routley, *Strategies for preserving and promoting Aboriginal and Torres Strait Islander people' history, culture, and practices in science education,* 2020.

[11] R Baynes, *Teachers attitudes to including Indigenous Knowledges in the Australian science curriculum*, 2015.

[12] P Joyce P and K Routley, *Strategies for preserving and promoting Aboriginal and Torres Strait Islander people' history, culture, and practices in science education*, 2020.

[13] CSIRO, *Indigenous STEM education project: final evaluation report*, p29.

### Supporting teachers and schools

Programs targeted at improving teacher knowledge of embedding Aboriginal and Torres Strait Islander perspectives into the curriculum need to be conscious that teachers are required to juggle multiple priorities and often lack time or resources to adopt new approaches.

The evaluation noted that teachers and schools need access to low or no-cost resources that are easy to access, use, and adapt. Programs should also allow time for teachers to fully adopt and grasp new content, and to observe 'whole-of-school' change. Whole-of-school, multi-year planning is a key success factor. For example, in the PRIME Futures program, a survey of participating teachers revealed that 45% noted lack of time as a key barrier to sharing what they learned with other teachers.

Many teachers and schools need additional support to build and nurture new relationships with families and communities to realise the benefits to developing and implementing a culturally responsive STEM curriculum.

Other research supports these findings on what is needed to increase the readiness and capacity for teachers to learn and embed culturally responsive STEM pedagogies, such as targeted pre-service teacher training, time and space to undertake professional development, and programs to build confidence in Aboriginal and Torres Strait Islander knowledges and teaching approaches and overcoming unconscious bias.[14]

### Need for systemic change

Program managers were focused on increasing participation and program operation, with limited opportunity to drive cultural or system-level changes in how jurisdictions or schools implemented STEM curriculum.

The evaluation recommended that a strategic approach to systems-level change is needed, including through engagement with government. The approach would also benefit from engagement with more diverse stakeholders representing both key program participants and underrepresented groups. It also proposes that pre-service teachers should have opportunities to learn about culturally responsive STEM learning programs (two-way science).

## Evaluation material

CSIRO completed annual evaluations throughout the project to draw on feedback from participants and communities and inform changes to the program as required. As mentioned above, this was a strength of the project. Drawing on the voices and perspectives of participants and First Nations communities and leaders helped to ensure the sub-programs were relevant and meeting the desired objectives. Evaluations completed were the:

- First monitoring and evaluation report, which examined implementation of the project from 2014-2016
- Second monitoring and evaluation report, which provided evidence of short-term outcomes being met (engagement and achievement) from 2014-2017

[14] R Baynes, Teachers' attitudes to including Indigenous Knowledges in the Australian science curriculum, 2015.

- Third monitoring and evaluation report, which provided evidence of progress towards achieving intended outcomes of the project from 2014-2018
- Final evaluation report, which provided evidence of the impact of sub-programs on educators, students, schools and the education system, and key lessons during the whole project period from 2014-2021.

The evaluation used a range of inputs and data to demonstrate progress towards outcomes, including:

- surveys, teacher assessments and administrative data to monitor achievement, engagement and attitudes
- jurisdictional data on student achievement and attendance (National Assessment Program – Literacy and Numeracy, grades)
- case studies of sub-programs, including focus groups and interviews
- review of research and evidence of what works in Indigenous STEM education.

# Conclusion

Lessons from the Indigenous STEM Education Project can add to the evidence base for program design approaches recommended by the review. While the approaches, successes and lessons from each individual program differ, key that themes emerged across the project are summarised below.

- Systemic change to embed new approaches to STEM education targeted at underrepresented cohorts requires centralised and intentional efforts that consider local contexts. The project evaluation found that program managers did not have the resources or capacity to influence broader implementation of successful initiatives, and changes to the education system. Dedicated time, planning and resources needs to be in place to influence systemic change.
- Teachers are influential in encouraging and supporting First Nations students to engage STEM education when they have the confidence in teaching and delivering culturally informed STEM content. However, they need to have the time and accessible resources for professional development.
- This kind of change takes time. Longer-term programs, combined with monitoring and evaluation are needed to measure the impact of programs on learning outcomes, engagement, and progression along the STEM pathway. Measuring long term impact is a common challenge across programs if this is not considered in the program design and funded from the outset.
- The project, while funded for seven years, was limited in showing long-term impact on student pathways due to the long period between program participation (often in primary or high school) and tertiary and career level outcomes. In addition, the influences on student outcomes are numerous and varied and it is difficult to attribute any changes to single

programs. Better and more longitudinal data collection would help, but not overcome, these issues.

- Hands-on and culturally responsive approaches to STEM education increased engagement for Indigenous (and non-Indigenous students who were in classes with teachers participating in professional development) – particularly for those who were 'underperforming' before participating in the program.
- Schools that were able to draw on the experience and knowledge of parents, local communities, Elders and Traditional Owners in developing the STEM curriculum supported engagement and sharing of culture. Schools without existing relationships with community may need additional support to build and utilise them effectively.

# Indigenous Girls' STEM Academy

The Indigenous Girls' STEM Academy is a national investment in high-achieving Aboriginal and Torres Strait Islander women and girls. It will **foster a generation of Aboriginal and Torres Strait Islander female leaders** in STEM and is comprised of 2 initiatives: the Young Indigenous Women's STEM Academy, and the Teachers of STEM Initiative.

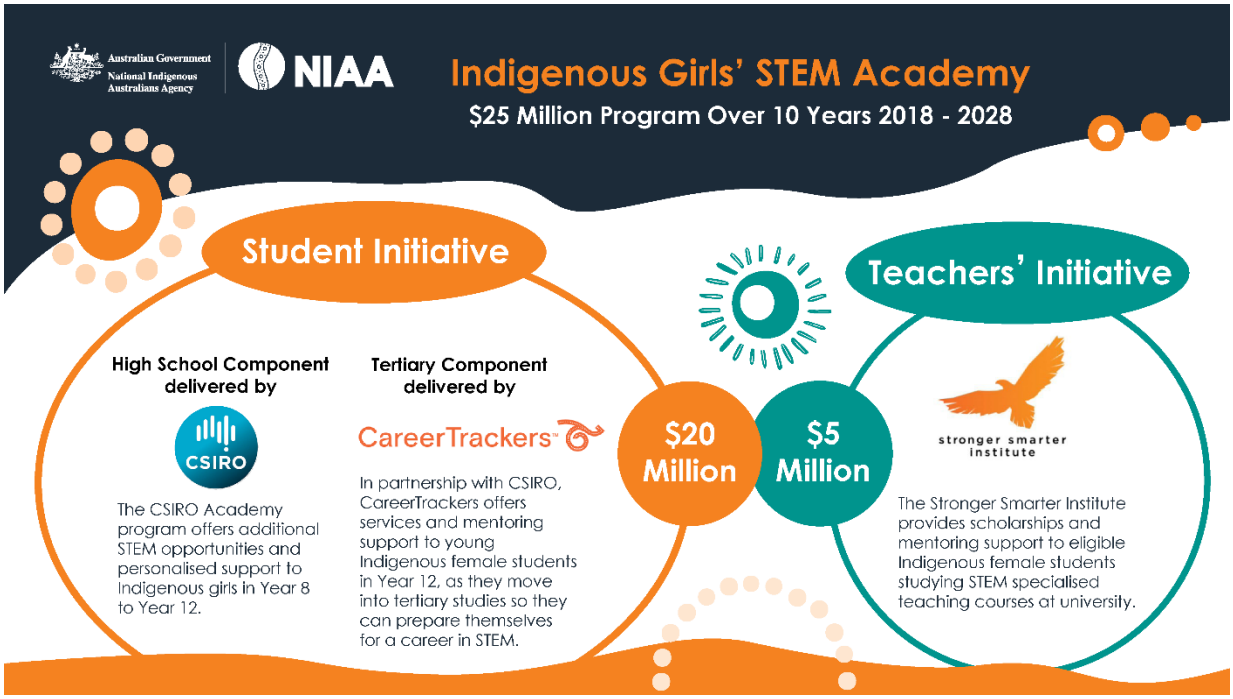
## Key lessons

- Efforts to provide long-term mentoring and support throughout the STEM pathway, from education to employment, can enhance student experiences and support retention. For example, through relationships with other participants, local academic coordinators, and mentors, and increasing representation among STEM teachers.[15,16] This could form part of broader best-practice guidelines about longer-term, strategic approaches for programs to support children and young people through the STEM pathway.
- Programs that are flexible, allowing for localised and tailored supports, avoid a 'one-size-fits-all' approach. This also acknowledges the diversity of individual aspirations and mentoring and support needs.
- Formal governance structures and partnerships that include diverse representation can help to ensure program implementation is safe and fit-for-purpose on an ongoing basis.
- Building monitoring and independent evaluation into program design, alongside program delivery, can capture what is working and what isn't working. This can inform improvements at an early stage, rather than waiting until after the program ends. This information can help maximise value and inform other similar programs.

[15] Taylah Griffin, interview with Mikaela Jade.

[16] Camille Goldstone, interview with Mikaela Jade.

*Figure 2: Indigenous Girls' STEM Academy Initiatives*




# Program summary

## Young Indigenous Women's STEM Academy

The Young Indigenous Women's STEM Academy is delivered by CSIRO in consortium with CareerTrackers. It provides mentoring and support to young First Nations women across their pathway from high school through tertiary study and into a graduate career. The initiative aims to mentor and support participants through challenges that may discourage them from pursuing STEM careers.

The Young Indigenous Women's STEM Academy aims to provide holistic and tailored support for up to 1,000 First Nations women and girls in STEM over the life of the initiative.

Individualised support is provided during their journey through high school, tertiary education and into careers. For example, STEM activities, peer networks, wellbeing support, and tutoring.

## Teachers of STEM Initiative

The Teachers of STEM Initiative is delivered by the Stronger Smarter Institute. It focuses on supporting 100 First Nations women to complete STEM teaching qualifications, and support teachers to incorporate First Nations Knowledges into STEM education in their classrooms.

The Teachers of STEM Initiative supports First Nations women to complete STEM teaching qualifications through, for example, scholarship support, mentoring or customised professional development, internships and/or placements.

The professional development program supports educators (not only First Nations teachers) seeking to improve the STEM educational experience of First Nations students in their classrooms.

Both initiatives are governed by Indigenous-led steering committees to help ensure delivery is focused on excellence in cultural awareness and responsiveness. This is reinforced by both the Young Indigenous Women's STEM Academy and Teachers of STEM Initiative being delivered by majority First Nations staff and leadership.

# Program delivery and funding

## Young Indigenous Women's STEM Academy

The National Indigenous Australians Agency (NIAA) provided $20 million of funding from 2018-2028 through the Indigenous Advancement Strategy to CSIRO in consortium with CareerTrackers to deliver the initiative. These funds support up to 1,000 First Nations young women to pursue their ambitions in STEM careers.

CSIRO delivers elements of the Young Indigenous Women's STEM Academy that provide mentoring and support for participants from Year 8 to Year 12. CareerTrackers provides mentoring and support for participants from Year 12 and into tertiary study, with exposure to STEM careers and employers.

The Young Indigenous Women's STEM Academy has 3 objectives:

- increase enrolments in STEM classes during high school
- increase enrolments in STEM tertiary studies
- support participants to attain high-quality STEM employment at the end of the program.

The design of the Young Indigenous Women's STEM Academy has been informed by lessons from the Indigenous STEM Education Project.[17] These include:

- the importance of providing wrap-around support throughout the education pathway
- the importance of cultural safety, inclusivity, and strength-based approaches
- engaging with First Nations people and communities before and during design and implementation to meet their aspirations for young women's education
- embedding monitoring and evaluation in design and implementation to ensure relevant, timely and impactful changes can be actioned from lessons during delivery.

[17] L Walker and C Banks, Indigenous STEM Education Project final evaluation report: September 2014 to June 2021. Canberra, Australia: CSIRO, 2021.

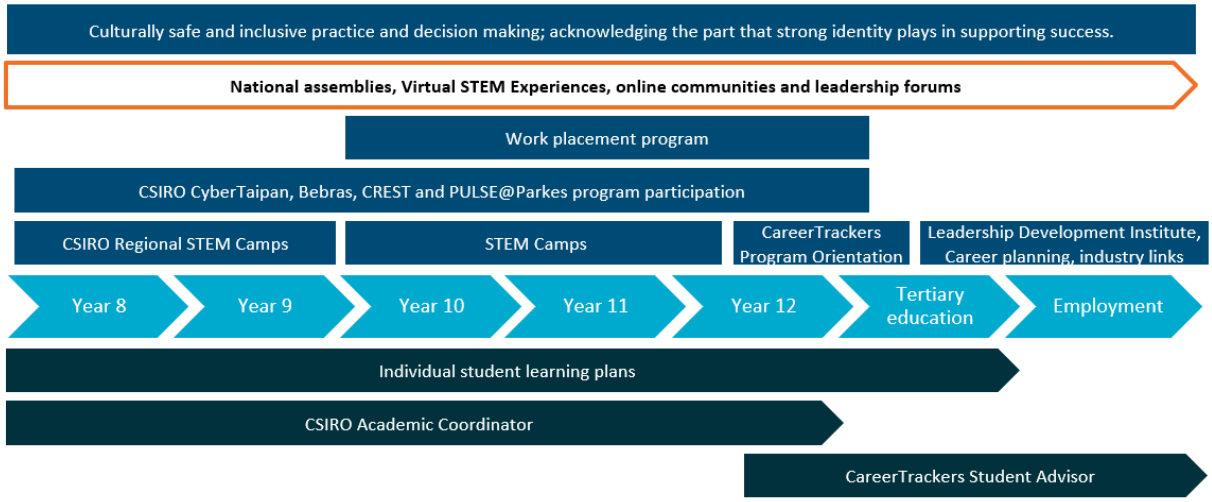
## Program operation

Participants are recruited in Year 8 via an application process, with teacher and carer support.[18] To be eligible, participants must be Aboriginal and/or Torres Strait Islander, be female or female-identifying, and be passing English, maths and science at school.

As they progress through high school and into tertiary study, participants are provided a culturally safe, inclusive environment with targeted, long-term mentoring and support.[19] This includes:

- a dedicated Academic Coordinator (nine out of ten are First Nations women), individual learning plan, continual mentoring/support to navigate systems and services and in some instances, financial assistance
- STEM opportunities, such as STEM camps,[20] virtual STEM experiences, work placements

*Figure 3: Young Indigenous Women's STEM Academy mentoring and support*[21]




CSIRO provides support from Year 8 to Year 12. Then, halfway through Year 12 participants are transitioned to CareerTrackers in preparation for tertiary study. CareerTrackers provide participants with ongoing mentoring/support to navigate the tertiary environment and links participants to employers through paid multi-year internships.

If participants decide to not continue with activities or support, for example to focus on their studies, the Young Indigenous Women's STEM Academy checks in periodically and leaves the door open for them to reconnect when support is required.

[18] https://www.csiro.au/en/education/Programs/Young-Indigenous-Womens-STEM-Academy/Join-the-Academy, accessed 7 August 2023.

[19] Submission to Diversity in STEM Review, Let's Talk Solutions from CSIRO.

[20] https://www.csiro.au/en/news/All/Articles/2022/August/young-indigenous-womens-stem-academy-camp, accessed 7 August 2023.

[21] CSIRO, provided to the Diversity in STEM Taskforce, September 2023.

## Progress to date

Commencing in 2018, CSIRO in consortium with CareerTrackers has implemented a staged rollout of the Young Indigenous Women's STEM Academy in targeted regions across Australia. New regions came online each year until 2023.

Regions were initially identified based on highest population of First Nations females aged 15-24, with access to educational institutions, transport, and First Nations services. COVID-19 significantly impacted recruitment of participants. As a result, the Young Indigenous Women's STEM Academy Steering Committee shifted to consider community interest and demand, and decided to increase the number of state-wide cohorts. A list of existing regions is in Table 4.

*Table 4: Young Indigenous Women's STEM Academy cohort region/state locations*

| Year level in 2023 | Cohort region/state |
|---|---|
| Year 8 | Queensland wide |
| Year 8 | New South Wales wide |
| Year 9 | Tasmania / Victoria |
| Year 9 | South Australia |
| Year 9 | Brisbane North |
| Year 10 | Northern Territory |
| Year 10 | Central Western New South Wales and Australian Capital Territory |
| Year 10 | Brisbane West |
| Year 11 | Western Australia |
| Year 11 | Newcastle / New South Wales Central Coast and Greater Western Sydney |
| Year 11 | National |
| Year 12 | North Queensland |
| Year 12 | Far North Queensland |

As of 30 June 2023, there were 463 women participating in the Young Indigenous Women's STEM Academy. This includes 330 in high school, 117 in tertiary study, and 15 alumni engaged in STEM careers or higher education.[22] Some key outcomes include:

- participants from the first Year 8 cohort to progress through Young Indigenous Women's STEM Academy are now in Year 12, with 73 participants considering tertiary pathway options in STEM. This translates to a 94.8% school retention rate, compared to the national retention rate of 63% First Nations female students[23]
- 15 participants have graduated from university and are either undertaking further tertiary education or working in their chosen STEM field

[22] Submission to the Diversity in STEM review, Let's Talk Solutions from CSIRO.

[23] Submission to the Diversity in STEM review, Let's Talk Solutions from CSIRO.

- over 70 individual STEM experiences have been delivered
- a network of Indigenous female STEM professionals has been created.

The Young Indigenous Women's STEM Academy is currently undergoing an independent evaluation to the mid-point of program delivery by ARTD Consultants (outcomes up to 2024). The evaluation will provide further insights on the initiative's success in meeting its objectives.[24] In its submission to the review, CSIRO highlighted some successful elements of the program design, including:

- co-designing the program with First Nations peoples, and employing predominantly First Nations peoples to lead and deliver the initiative
- employing First Nations Academic Coordinators who have time to understand individual participant interests and supports needed, ensuring they are culturally appropriate and relevant
- fostering collaborative partnerships with other organisations to provide more holistic support
- mentoring and supporting women to build networks with likeminded young First Nations women in STEM disciplines to support them throughout the pathway
- engaging First Nations female STEM professionals to inspire the participants by sharing their journeys, including their pathways and strategies used to overcome challenges
- providing culturally safe and appropriate hands-on STEM experiences targeted at participants' areas of interest.

## Teachers of STEM Initiative

The Stronger Smarter Institute is a not-for-profit, Indigenous led organisation. The Stronger Smarter Institute has a suite of programs available to schools, organisations, and community.

The Stronger Smarter Institute believe that schools and communities already hold the resources, knowledge, and expertise they need to approach organisation challenges. The Stronger Smarter Approach™ begins by developing a positive sense of cultural identity and then looks deeply at how the Institute communicates and interacts with others, using the concept of High-Expectations Relationships. For over 15 years, the Stronger Smarter Institute has brought these discussions to the forefront of Australia's education system.

The Stronger Smarter Institute was provided $5 million over 10 years from 2018 through the NIAA to deliver the Teachers of STEM Initiative.

The Teachers of STEM Initiative delivers financial, and mentoring supports for the training of up to 99 new STEM specialised Aboriginal and/or Torres Strait Islander female teachers, with focus on the following key cohorts:

- Aboriginal and/or Torres Strait Islander women working towards STEM teaching qualifications

[24] https://www.niaa.gov.au/indigenous-affairs/grants-and-funding/funding-under-ias/evaluation-work-plan/indigenous-girls-stem-academy, accessed 7 August 2023.

- Aboriginal and/or Torres Strait Islander educators and non-Indigenous educators that have an impact/influence on Aboriginal and/or Torres Strait Islander students.

By increasing the number of Aboriginal and/or Torres Strait Islander teachers in STEM the initiative aims to improve STEM connection and educational experience of Aboriginal and Torres Strait Islander and all school students in Australian classrooms.

### Program operation

The Teachers of STEM Initiative provides scholarships to cover up to a four year Bachelor of Education degree. Aboriginal and/or Torres Strait Islander women are eligible if they are seeking to study a STEM teaching qualification, upgrade their existing teaching qualification with a post graduate qualification in STEM or study a Master of Teaching to support their existing STEM qualification.

Separate to the teaching scholarships, the program provides 3 professional development opportunities:

- Jardibirrijba
- Jardi Dadarrinyi
- Jarlarla.

All programs are designed to support scholarship participants with targeted mentoring and Indigenous Knowledges in STEM.

First Nations people being able to study in a culturally safe and supportive environment is equally important to understanding the diversity First Nations women bring to Indigenous Knowledges in STEM.

For many First Nations people, including some of the Teachers of STEM Initiative women, STEM is associated this with a western way of thinking; science, technology, engineering and maths, and how it has been traditionally taught in schools. Particularly, how the western system inadvertently disengages girls and/or women from choosing this as a career or passion.

Through the Teachers of STEM Initiative, and the professional development programs offered, the Stronger Smarter Institute see this fundamental and important shift from western way of thinking, to offering 65,000 years of diversity in STEM through the traditions passed down from First Nations ‘experts’.

Jardibirrijba is an induction program that provides fundamental groundings. The program introduces the women to the Teachers of STEM Initiative and its objectives. It outlines the different supports and incentives available whilst studying. Each participant is provided with a High Expectation Personal Development Plan to ensure their educational journey is supported.

Shifting STEM thinking to Indigenous ways and Indigenous Knowledges gathers strengths from Elders and community though strength-based approaches, such as the Jardi Dadarrinyi program.

The Jardi Dadarrinyi program provides the opportunity to recognise the power, influence, and impact that each participant can have on schools, school staff and students. Through this program, important connection to experts from local communities in Indigenous Knowledges.

The program brings together the diversity that often western ways of thinking cannot deliver in the classroom.

Both Jardibirrijba and Jardi Dadarrinyi provide women participating with different ways to approach their teaching careers. Westernisation of the Australian curriculum does not lend itself to pursuing Indigenous Knowledges in STEM and/or a career in STEM for many Indigenous women. The Jardibirrijba, Jardi Dadarrinyi and Jarlarla programs support Aboriginal and Torres Strait Islander women to:

- incorporate culturally responsive ideas and strategies into curriculum
- make connections with community
- strengthen Indigenous Knowledges and professional practice of STEM into the classroom.

The Jarlarla program is a culturally inclusive and diverse program that supports First Nations teachers and non-Aboriginal teachers. This program empowers participants to project themselves into a STEM career, providing support and ideas for taking Indigenous Knowledges in STEM into the classroom, ensuring they work with communities and their local Indigenous experts.

The Jarlarla program aims to build correlations between STEM and Culture. Without cultural perspectives, diversity losses its scientific ‘talent’ or ‘experts’. This cultivation of talent is important and is reached through providing teachers with culturally responsive and scientific ways of knowing. It comes from the desire to ensure that all educators have a deeper understanding of their own diverse backgrounds to ensure equal representation of each perspective and understand how to incorporate Indigenous Knowledges in STEM into a curriculum that is accessible to all students, especially First Nations women wanting to study or have a career in STEM.

### Progress to date

At the halfway point of the Teachers of STEM Initiative:

- 6 women have completed their studies.
- 42 women are enrolled
- participants have an 81% unit pass rate.

The number of participants in the program are:

- Jardibirrijba – 48 participants completed.
- Jardi Dadarrinyi – 10 participants completed.
- Jarlarla – 82 participants completed.

The numbers above show teacher’s interest in wanting to know ‘how’ to teach Indigenous Knowledges in STEM in the curriculum, whilst also challenging western science as the ‘only’ science. Participants report a lack of understanding of our First Nations people culture and protocols. The Stronger Smarter Institute’s important work with building and facilitating close connections and relationships with culture and identity, continues to inspire teachers to have high expectations of themselves but more importantly, their students and their diverse backgrounds that they bring into the classroom every day.

## Successful program elements

The programs support Aboriginal and Torres Strait Islander participants to build their STEM qualifications and provide them with the 'tools' to incorporate their own Indigenous Knowledges in STEM curriculum and different educational platforms. Providing an opportunity for Aboriginal and Torres Strait Islander students to see diversity in their classrooms, they can see the relevance and be inspired to become leaders and/or educators in their communities. It is this link to First Nations STEM teachers that has been reported by Teachers of STEM Initiative participants who have inspired them in their own classrooms to attract more First Nations scientists in the future.

The importance of Teachers of STEM Initiative participants having access to the scholarship and professional development opportunities supports their success. This is evident from the passion of participants to support each other. Participants have reported that without the financial and holistic supports provided through the individualised support, they would not have been able to complete their degree because of the on-going pressures of work-life balance.

Supports provided by Teachers of STEM Initiative mentors and professional development programs are represented across the country. For example, the Jarlarla program has 82 participants offering the opportunity to engage with local Indigenous Knowledge STEM specialist in local settings, nation-wide. The numbers below show a wide reach into schools and the community:

- 58 participants from 48 schools
- 19 from education support areas (university and education departments)
- 5 from community organisations.

Participating teachers have reported to being positively impacted by the different ways in thinking about how Indigenous Knowledges can be linked to the school curriculum. They have also highlighted the importance of understanding local Indigenous Knowledges in STEM by making connections to the local environment and examining their own ways of thinking to build stronger connections with the students in their classrooms.

The impact of this program is seen with the ongoing interest from 42 teachers[25] and schools enquiring about the Stronger Smarter Institute's professional development programs. These programs build on Teachers of STEM Initiative's own Indigenous Knowledges and skills to influence their students to develop an increased interest and passion in STEM.

The Teachers of STEM Initiative aims to support the STEM teachers standing in front of Aboriginal and non-aboriginal students to inspire and create a generational passion, commitment to Indigenous Knowledges in STEM, and decrease the gap of diversity in STEM for all students.

[25] Stronger Smarter Institute, *Salesforce leads source report,* October 2023.

# Evaluation and findings

The Indigenous Girls' STEM Academy, and its two initiatives, are currently being evaluated until its mid-term delivery point (2024) by an independent evaluation consultant commissioned by NIAA to provide further insights on its success in meeting its objectives to help inform ongoing delivery. The Indigenous Girls' STEM Academy, and its design, has already shown some early success after five years of delivery. The elements of program implementation, as discussed above, could inform the approach to other diversity in STEM programs or sectors.

# Conclusion

The Indigenous Girls' STEM Academy provides an examples of program elements that could be considered as part of program design for diversity in STEM initiatives. A key element is approaches that provide support to underrepresented young people in STEM as the move through high school and into higher education, rather than one-off support. As part of this, programs should require monitoring and evaluation throughout delivery to ensuring the program is achieving long-term outcomes.

To ensure programs are safe and appropriate, embedding formal governance structures that include diverse representation, and can provide advice and leadership from lived experience.

Supporting diverse representation and role-models can also help young people connect and see themselves in STEM career pathways (e.g. increasing diversity in STEM teachers, and prioritising diverse program leadership, mentors and support staff). Drawing on Indigenous Knowledges in STEM is shown to be an important element of both STEM teaching and learning, particularly local Indigenous Knowledges, and supporting teachers to understand how these can be incorporated into the curriculum.

# RLabs

RLabs is a not-for-profit organisation that offers a range of technology-related courses and resources to **support upskilling and creating economic opportunities** in the community. It is an example of an initiative that started as a community-led program (i.e. without government) that is now an internationally recognised not-for-profit organisation.

## Key lessons

- The following factors have been key for RLabs' ability to grow from a community-based initiative to an internationally recognised not-for-profit organisation:
  - RLabs commitment to the local community, by developing products and services used in the community, providing assessable and low-cost opportunities to upskill/reskill has helped RLabs build its reputation in the community. It is well respected as an organisation that drives social change
  - understanding early in the implementation stages of RLabs the need to be self-sustaining (by developing commercial mobile applications, products and services)
  - establishing stakeholder relationships in industry, academia, community, and government and incorporating that into the governance structure of RLabs.
- Publicly available evaluation and monitoring of RLabs is mainly through case studies of specific projects within RLabs and participant feedback. It is acknowledged by RLabs staff that further long-term evaluation would be beneficial[6], however, there is no indication that this has occurred.

## Program summary

RLabs began in South Africa in 2008.[26] The motivation to create RLabs was led by founder Marlon Parker at Cape Peninsular University of Technology (CPUT) who had a desire to provide options for at-risk youth in a community impacted by significant substance abuse.

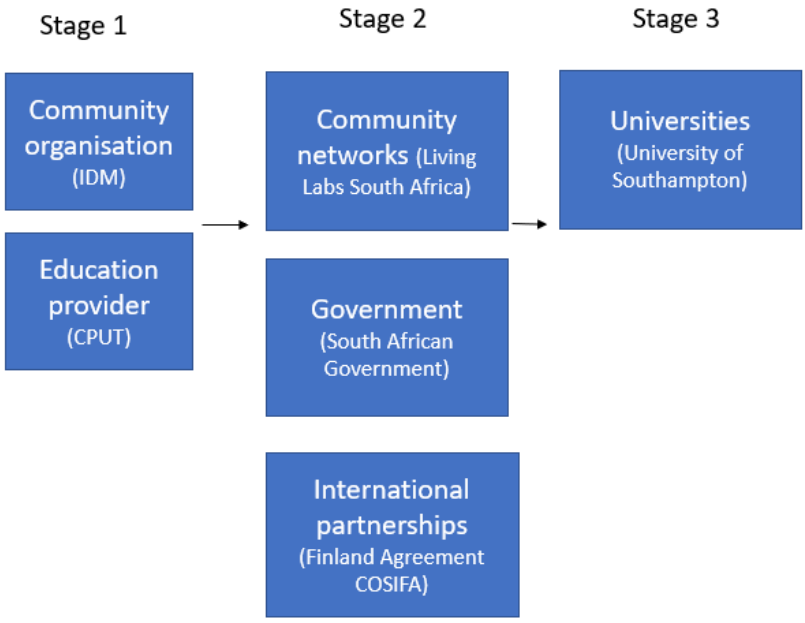
[26] J Wills, M Parker and G Wills, 'Reflective evaluation of civil society development: A case study of RLabs Cape Town, South Africa', *The Journal of Community Informatics*, 2015, 11(3): 1-23.

A ‘Living Labs’ model (defined as a real-life test and experimentation environment that fosters co-creation and open innovation[27]) was used to bring together socially motivated individuals and community organisations to develop initiatives to support at-risk youth.

The first stage of RLabs in 2005 was a collaboration project between community organisation Impact Direct Ministries (IDM) and CPUT. The aim was to use innovative IT solutions to facilitate health and social care for residents in the community and empower RLab participants to drive change in their community.

RLabs developed a mobile instant messenger aggregator app which is used to manage multiple mobile chat conversations.[28] The app provided a low-cost messaging option for users with a 3G enabled mobile device. This was then used in a drug advisory service pilot that was tested in the community.[29] RLabs commercialised the software, which provided a source of income to build and expand RLabs to become a self-sufficient social enterprise in 2008, managed by a board of directors and an advisory non-executive board with representatives from industry, academia, community and government (see Figure 4).

*Figure 4: The 3-stage expansion of RLabs to becoming a self-sufficient social enterprise (adapted from M Parker, J Wills and G Wills, 2013)*




[27] https://enoll.org/about-us/ accessed 12 September 2023.

[28] M Parker, G Wills and J Wills, G, ‘Rlabs: A South African perspective on a community-driven approach to community information’, *Journal of Community Informatics*, 2013, 9(3).

[29] M Parker, G Wills and J Wills, *Using mobile instant messaging to support the substance abuse problem amongst youth in South Africa*, 2010.

RLabs has expanded and increased its offerings with the broad aim to 'make hope contagious' and to 'create environments and systems where people are impacted, empowered and transformed through hope, innovation, technology, training and economic opportunities'.

These offerings include RLabs Academy, which offers education and training (RLabsU, RLabs Youth, RLabs Women, GROW Leadership Academy, Skills Accelerator, NextGen) and a business incubator (InnovIA, Innovation Lab). These offerings all aim to provide RLab participants with the skills (including leadership, entrepreneurship, digital skills, coaching) to empower participants to drive change in their community. To date, more than 200,000 people have accessed RLabs skills, training and economic empowerment programs.[30]

Of note is RLabsU, which is a franchise with resources to implement low-cost education and training to the local community. RLabs Women has initiatives such as StartUp Women, DigiWomen, Junk.fund and Virtual Reality.

# Program delivery

RLabs has a range of offerings for the South African community. Two examples are outlined below.

## Development of other IT solutions: Uusi mobile website

- Youth unemployment is a challenge in South Africa, including the West Cape region where RLabs is based. Uusi is a RLabs initiative that utilises the mobile aggregator technology developed by RLabs and to address unemployment in the Western Cape region.[31]
- Uusi is a mobile website that lists job opportunities and does not charge a registration cost, providing an affordable option for both job seekers and those wanting to advertise jobs but cannot afford to advertise using conventional recruitment methods (e.g. newspaper advertisements).
- During prototype testing, it received positive feedback from users, and has had half a million users on the platform. However, it is unclear if users successfully obtained employment from using Uusi.[32]

## Addressing youth unemployment

- RLabs has identified youth unemployment as an area of ongoing focus, with some of their initiatives listed in Table 5.

[30] From the Rlabs website (https://rlabs.org/) accessed 19 June 2023.

[31] SC Smith, M Parker and T Hendricks, *The use of mobile technologies to address unemployment in the Western Cape,* 12th Annual Conference on World Wide Web Applications, Durban, 21-23 September 2010 (http://www.zaw3.co.za).

[32] V Dieltiens, 'A foot in the door: NGOs as workplace intermediaries in the South African youth labour market', Research Project on Employment, Income Distribution and Inclusive Growth (REDI3x3) working paper 11, 2015, p1-19.

*Table 5: RLabs youth unemployment initiatives*

| | |
|---|---|
| **RLabs – GROW Leadership Academy** | 12-week course that includes an intensive process of self-reflection and peer counselling |
| **Youth Cafes – Collaboration with RLabs and Western Cape Department of Social Services** | A space where youth (16-25 years of age) can access internet, printing facilities and food with virtual currency. Youth have to 'do good' (volunteer work, attend a life-skills course at the cafe etc.) to earn currency that is loaded on their cell phones. The idea is to get rid of all the direct costs to finding jobs (internet, printing, transport, and personal appearance). |

# Evaluation and findings

## Self-reported evaluation of RLabs

- RLabs staff (including one of the founding members) used RLabs as a case study to identify elements of the program important for program implementation and sustainability.
- Key RLabs staff were interviewed as part of the case study about what elements of the program they considered was key to the implementation and sustainability of community development programs, listed in Table 6.

*Table 6: RLabs key program elements*

| | |
|---|---|
| **Time** | The vision of a community led organisation to support at risk youth was something that had been in development since 2001. This allowed the RLabs founders time to obtain the resources they needed (e.g. relevant expertise, physical resources). |
| **Staff retention** | People involved with RLabs (including the founders) have stayed connected with the program in some capacity which has been helpful to retain knowledge within the organisation as RLabs developed over time. |
| **Living Lab model** | A Living Lab model allowed different stakeholders (community organisation, education providers, program participants) to combine resources and work together and allowed RLabs to retain a community focus. |
| **Physical space** | Being provided a physical space for the initial group to meet and work was integral to its success. |
| **Social motivation** | There was a need to develop community-based programs for at risk youth and provide them with the supports they needed. The expectation of RLabs is that participants give back to the community – 'making hope contagious'. |

## Government-led evaluation of Living Labs, including RLabs

This was an evaluation commissioned by the Department of Science and Technology in the South African government to understand the outcomes of six different Living Labs in South Africa, including RLabs.[33] Focus groups consisting of staff from IDM and program participants were asked a series of questions about RLabs.

Key findings from this evaluation were:

- RLabs is well received and trusted by participants and the wider community – it is an initiative that is embedded within the community.
- Management team have a shared vision and operate RLabs using a value-based approach (*"making hope contagious"*).

## Academic case study comparing 5 Living Labs in South Africa

This was an academic case study comparing five learning labs in South Africa, including RLabs.[34] Each of the five learning labs in the study address socio-economic challenges in the community, such as:

- establishing community e-services (for example, community access to health, judiciary and government services)
- digital literacy programs.

For the RLabs case study, it was found that evaluation and monitoring was done at the project level (via online feedback).

RLabs was key to establishing the Living Labs network in South Africa, which allowed other community led Living Labs to build on its model and benefit from the network.

# Conclusion

RLabs is an example of a community-led program with international reach that is built on the desire to create social change within the community using digital technology. While it did not initially focus on STEM or women in STEM, it has developed resources that engage individuals from disadvantaged cohorts such as unemployed youth and women. It also highlights the importance of empowering individuals with the skills and expertise to drive social change.

[33] Economic Performance and Development, Human Sciences Research Council, *A diagnostic study of Living Labs in South Africa*, 2018.

[34] H Coetzee H, I-M Du Toit and M Herselman M, 'Living Labs in South Africa: An analysis based on five case studies', *The Electronic Journal for Virtual Organizations and Networks*, 2012, 14:1-29.

# Maths Multiplies Your Choices

‘Maths Multiplies Your Choices’ is an example of a **government media campaign** from 1989 that targeted the parents of girls aged 13-15, and the girls themselves to encourage enrolment in maths and science subjects in school by highlighting a wider range of future career options that they may not have originally considered.[35,36,37]

## Key lessons

- Survey results from secondary schools, parents, and Year 10 girls indicated that Maths Multiplies Your Choices increased rates of enrolments in maths and science subjects.[38,39]
- Once the campaign ended (after one semester) the number of girls enrolling into maths and science subjects in Year 11 decreased to its original rate. [40,41]
- There is no evaluation to determine the long-term impacts of the campaign. Future campaigns need to have sustained, long-term funding and support to monitor and evaluate long term outcomes.
- Though the campaign was discontinued, it offers evidence of a successful way to engage with the parents of young girls and young girls themselves to encourage them to enrol in maths and/or science subjects and pursue STEM careers in the future.

[35] K McAnalley, K, ‘Encouraging parents to stop pigeon-holing their daughters: The ‘Maths Multiplies Your Choices’ Campaign’, *v.i.e.r. bulletin,* 1991, no. 66.

[36] Department of Labour, Victoria, ‘How maths multiplies your daughter’s choices’ pamphlet, 1989.

[37] Women’s Employment Branch, Department of Labour, Victoria, ‘Maths multiplies your choices’ pamphlet, 1990.

[38] K McAnalley, K, ‘Encouraging parents to stop pigeon-holing their daughters: The ‘Maths Multiplies Your Choices’ Campaign’, *v.i.e.r. bulletin,* 1991, no. 66.

[39] Gender issues in maths: Issues and challenges, https://www.education.vic.gov.au/school/teachers/teachingresources/discipline/maths/Pages/research_genderissuesinmaths_issues.aspx, accessed 28 June 2023.

[40] K McAnalley, K, ‘Encouraging parents to stop pigeon-holing their daughters: The ‘Maths Multiplies Your Choices’ Campaign’, *v.i.e.r. bulletin,* 1991, no. 66.

[41] Gender issues in maths: Issues and challenges, https://www.education.vic.gov.au/school/teachers/teachingresources/discipline/maths/Pages/research_genderissuesinmaths_issues.aspx, accessed 28 June 2023.

# Program summary

Maths Multiplies Your Choices was a government funded state-wide media campaign run in Victoria by the Department of Labour between mid-July and early November of 1989, to coincide with the time that girls would select subjects for school the following year. It targeted parents with daughters between the ages of 13-15, with girls aged 13-15 being the secondary target. The campaign slogan was *'Don't pigeon-hole your daughters'*.

The immediate aim was to motivate and encourage teenage girls to consider technical and scientific careers, with the idea that they should choose science and maths courses at school to prepare for these careers. The long-term goal of the campaign was to increase the number of women working in a wider range of occupations, particularly in the science and technology fields, though this long-term goal was never monitored or evaluated due to the discontinuation of the campaign in 1990.

The campaign comprised:

- two 30 second television commercials shown during 'family viewing time'
- six 30-45 second radio advertisements which went to air on the radio stations that predominantly young girls listened to
- press advertisements
- tram panels aimed at parents as well as commuting students
- letters sent out to parents of all girls in Year 10 explaining the messaging behind the campaign
- information booklets for parents.

The overall purpose of the campaign was to:

- challenge the assumptions and adjust the attitudes of parents, girls and the wider community around appropriate career options for women
- show that maths and science studies can lead to good career prospects with higher salaries than many of the jobs in which women were employed in at the time
- encourage parents to promote the continuation and importance of maths and science studies to their daughters.

# Program delivery and funding

The campaign was delivered by the Department of Labour in Victoria from mid-July to early November 1989.[42] Key elements of the campaign included:

[42] K McAnalley, K, 'Encouraging parents to stop pigeon-holing their daughters: The 'Maths Multiplies Your Choices' Campaign', *v.i.e.r. bulletin,* 1991, no. 66.

- approximately 300 television advertisements were distributed during 'family viewing time'[43]
- over 900 radio advertisements that went on air on radio stations that were aimed at young girls
- 16 newspaper advertisements, including in community-based news outlets.

  tram panels that were aimed at parents as well as students commuting to school were displayed, though the number is unknown
- about 25,000 pamphlets and 900 informational booklets were also distributed.

Approximately $1 million of funding from the Victorian Government was provided for the campaign. After it was decided that the campaign would no longer continue, girls' enrolments in maths and/or science subjects decreased to where they had been prior to the campaign. Due to the discontinued funding, evaluation of long-term impact of the campaign could not completed.

# Evaluation and findings

To evaluate the success of the campaign, market research was commissioned by the Department of Labour to monitor attitudinal changes of parents and girls. This research indicated that there was an extremely high level of awareness of the campaign's message. About 98% of girls in Year 10 and 91% of parents had seen or heard advertising about encouraging girls to continue with maths and science in Years 11 and 12.[44] However, due to the end of the campaign, there was no further funding for long-term evaluation, and so the long-term effects of the campaign were not determined.

## Secondary school survey outcomes

A survey of 40 secondary schools after the campaign found an increase in enrolments in Advanced Maths, Chemistry and Physics for girls at Year 11. As a contrast to previous evidence at the time that overall participation rates in these subjects was decreasing, it was believed that the campaign had acted as a catalyst for girls to make more informed subject choices in maths and science subjects. However, though it had influenced attitudes and behaviours significantly, it could not be determined if the campaign was the sole reason for the increase in enrolments due to the lack of funding for evaluation following the closure of the campaign.

## Parental survey outcomes

A survey of approximately 400 parents was conducted both before and after the campaign that focused on parental perceptions. In the post-campaign survey, 44% of parents said that they had discussed the issue of limited career options with their daughters as a direct result of campaign advertising. This was considered a significant result by the market researchers

[43] A television advertising example: https://www.amsi.org.au/maths_multiplies/maths_multiplies.html.

[44] K McAnalley, K, 'Encouraging parents to stop pigeon-holing their daughters: The 'Maths Multiplies Your Choices' Campaign', *v.i.e.r. bulletin,* 1991, no. 66.

conducting the study, as before the campaign parents had tended to avoid advising their daughters about career choices. Parents also said that they felt more confident in advising their daughters to continue education in maths and sciences because of the campaign.

Other attitudinal outcomes of the campaign revealed by the parental surveys included:

- 10% increase in the belief that daughters were very likely to pursue a full-time career
- 13% increase in the belief that daughters would select a career in the maths and/or science fields
- 19% increase in the belief that daughters would find that maths and/or science related fields offer better career opportunities.

It was also noted within the campaign evaluation booklet produced by Victoria's Department of Labour that there were about 1,650 called-in enquiries made to the Information Line, 80% of which were parents calling on behalf of their daughters, which was a further indicator of success.

## Year 10 girl survey outcomes

Approximately 400 Year 10 girls were also surveyed before and after the campaign. The results showed that there was an increase (from 56% to 78%) in the belief of those surveyed that a background in maths and science would lead to better career prospects than subjects selected from the humanities area. Along with this increase, 17% of girls had opted to continue with maths and science into Years 11 and 12 when they had previously no intention to do so before the campaign.

The survey also found that as a direct result of the campaign:

- 13% more girls in school were likely to say *'I am more committed to maths and/or science'.*
- 13% more girls in school were likely to say *'Maths is a more popular subject for me'.*
- 22% more girls in school were likely to say *'I am receiving more encouragement to continue with maths and/or science'.*

## Findings

The results of the campaign provide evidence for the potential use of media campaigns to influence behavioural change and adjust perceptions about diversity in STEM. This campaign focused on increasing the number of Year 10 girls enrolling in STEM subjects in school, but in doing so it had to address the societal stereotypes associated with gender and occupations related to STEM. It succeeded in shifting parental perceptions as well as the attitudes and behaviours of Year 10 girls by framing advertisements in a way that suggested that gender should not limit, or 'pigeon-hole', girls in their career options. It instead suggested or 'nudged' parents to encourage their daughters to explore potential options of careers that require maths and science subjects. The methods used within the campaign relate to those commonly associated with behavioural economics and could inform approaches to increasing diversity in STEM.

For instance, the success stemmed, at least in part, from the exposure that girls and their parents had to easily understood information (informational nudges) that were accessible through advertisements on varied platforms commonly used by both groups.[45,46] This information was framed in a way that challenged stereotypes and societal norms, and this method could be adapted to apply to other cohorts in the future.

Though the campaign only ran for one semester, it was considered successful by Victoria's Department of Labour due to the:

- increase in girls who enrolled in maths and science subjects in the following year
- number of enquiries received by parents during the campaign
- results of surveys conducted with secondary schools, parents and Year 10 girls.

However, after it was declared a success, funding for the campaign ceased and the next year found girls' enrolments in maths and/or science subjects decreased to where they had been prior to the campaign.

Continuous national or community-wide campaigns that focus on framed messaging could aid in adjusting current cultural and community-based perceptions of STEM. Such campaigns could also aid in reforming current perceptions of STEM pathways, such as the differences between STEM courses provided through vocational education and training, industry training, and university.

At the same time, it is important to keep in mind that the reduction in maths and science enrolments after the termination of the campaign indicates that campaigns need to be long-term (and the measurement and monitoring of their impact supported) if enduring change is to be realised.

[45] K McAnalley, K, 'Encouraging parents to stop pigeon-holing their daughters: The 'Maths Multiplies Your Choices' Campaign', *v.i.e.r. bulletin,* 1991, no. 66.

[46] Department of Labour, Victoria, 'How maths multiplies your daughter's choices' pamphlet, 1989.

### Criticisms

Though deemed successful, the campaign was criticised by humanities teachers and schools attempting to cope with increased interest in maths and science, saying that the focus on maths and science would cause detriment to humanities fields. This suggests that the message of the campaign may not have been conveyed adequately at schools, as the message was meant to imply that girls should consider the implications to their careers before they discontinue maths subjects not to say *'all girls should do maths'*. [47]

# Conclusion

Maths Multiplies Your Choices successfully created attitudinal change in parents and in young girls in considering maths and/or science subjects in schools and potential career paths and opportunities that could be pursued as a result of enrolling in these subjects. However, due to the short term of the campaign and the discontinued funding, no evaluation of long-term impacts is available. If education campaigns aimed at behaviour change are implemented in the future, they should be provided long-term funding so that the campaign can operate over multiple years, so that performance data can be collected, and so that it can be evaluated to understand both short and long-term impacts.[48] [49]

[47] K McAnalley, K, 'Encouraging parents to stop pigeon-holing their daughters: The 'Maths Multiplies Your Choices' Campaign', *v.i.e.r. bulletin,* 1991, no. 66.

[48] S Evans-Lacko, J London, K Little, C Henderson and G Thornicroft, 'Evaluation of a brief anti-stigma campaign in Cambridge: do short-term campaigns work?', *BMC Public Health,* 2010,10:339.

[49] Australian Mathematical Sciences Institute submission, Review to Achieve Educational Excellence in Australian Schools, https://www.education.gov.au/system/files/documents/document-file/2020-12/australian-mathematical-sciences-institute.pdf, accessed 8 September 2023.

# Appendices

# Indigenous STEM Education Project evaluation summaries

# Appendix A: Aboriginal Summer School for Excellence in Technology and Science (ASSETS)

## Program focus

Supporting high-achieving Year 10 Aboriginal and Torres Strait Islander students to explore and study career options in STEM—499 students participated in summer schools and 93 participated in work placements.

## Delivery methods

The program had three primary components.

- Intensive 9-day residential summer school that focused on cultural leadership and inclusion of First Nations knowledges, academic development through scientific inquiry, leadership and development activities and development of education plans.
- Ongoing tailored leadership program, including networking events, STEM work placements, online forums, personalised assistance through Years 11 and 12 into tertiary education.
- Integrated and overarching cultural program with opportunities to share and explore Aboriginal and Torres Strait Islander cultures.

## Key findings and lessons

- Students in the program self-reported STEM subject achievement, with 98% reporting scores in the top three assessment bands for science, 94% for maths and 75% for technology and engineering. This was not surprising as students were already high performing in STEM.
- A survey of 2014-15 and 2015-16 participants revealed 97% completed Year 12 and 67% were attending university or TAFE. It is not clear if students progressed in STEM higher education. A Destination Survey Report found that all 10 of the program alumni were engaged in higher education studies, including eight in STEM-related fields.[50]
- Tailored content and connection with STEM professionals, and creation of an alumni network helped build participant confidence and awareness of future career options in STEM.
- The integration of Aboriginal and Torres Strait Islander knowledges was enjoyed and valued by participants; this was bolstered by engagement with their community.
- There was a high degree of uptake in the program, with consistently more applications than places.

[50] C Banks. and ASSETS Alumni, ASSETS destination interviews data report, CSIRO, Canberra, 2020.

*Table 7: ASSETS outcome summary*

| Measurable program outcomes | Progress towards outcome | Outcome theme |
|---|---|---|
| Students have a better understanding of and confidence pursuing STEM career pathways with subject choice and referencing prerequisite for university STEM courses | Transformative<br><br>High level of evidence | Education (Student) |
| Students are more aware of the relevance of Aboriginal and Torres Strait Islander scientific knowledges for STEM and are able to explore share and strengthen connections to culture | Transformative<br><br>High level of evidence | Community and cultural connection |
| Growth in student and professional networks | Effective<br><br>High level of evidence | Education (Student) |
| High aspirations for students with a focus on STEM careers | Effective<br><br>High level of evidence | Education (Student) |
| Student participation in broader STEM initiatives – e.g. work placements. Awards programs, Creativity in Research, Engineering, Science and Technology, BHP Science Awards | Effective<br><br>Medium level of evidence | Education (Student) |
| Schools, jurisdictions, stakeholders valuing summer school and leadership program, resulting in greater demand | Effective<br><br>Low level of evidence | Education (sector) |
| Continued student success in STEM subjects in Years 11-12, particularly direct university entry from Australian Tertiary Admission Rank | Effective<br><br>Low level of evidence | Student attainment, engagement and aspiration |
| Active, engaged, skilled and growing alumni community and professional network | Effective<br><br>Medium level of evidence | Student attainment, engagement and aspiration |
| Cohorts of role models, both mentors and students championing Indigenous knowledge | Effective<br><br>Medium level of evidence | Education sector /systemic outcomes |

# Appendix B: Bachelor of Science (Extended)

## Program focus

A four-year degree program at the University of Melbourne providing a supported pathway for Aboriginal and Torres Strait Islander students to complete a Bachelor of Science degree who have shown potential in science but may not otherwise have had the opportunity. This is now an ongoing course at the University of Melbourne. The program enrolled 45 students between 2015-2019.

## Delivery methods

- The course takes a 'scaffolded' approach to support students in their degree by incorporating Aboriginal and Torres Strait Islander perspectives in the science curriculum.
- Students take integrated subjects through the first three semesters to refine and consolidate STEM knowledge, before progressively transferring to a standard course structure.
- Students are also provided access to services to become more familiar with the university, process, and staff, and are offered academic skill development sessions.

## Key findings and lessons

- Retention rates varied by cohort, but most compared favourably to the retention rate of 71.2% for all Aboriginal and Torres Strait Islander Bachelor students. The small cohorts make it difficult to draw strong conclusions from the retention data.
    - Family and peer support and pivotal to student well-being and retention. Financial hardships and family obligations also had an impact.
- Attendance as linked to achievement, however, attendance rates were low and inconsistent for some.
- There was mixed feedback from students on their levels of engagement. Some found the content too broad or the pace too slow initially, others found the content interesting.
    - Some students felt particularly engaged when they could use and connect their existing Indigenous scientific knowledge with western scientific knowledge.
- University staff reported changes to their teaching practice, such as furthering Indigenous engagement with their faculty.
    - This needs to be balanced with ensuring content is culturally appropriate and respectful of the diversity of Aboriginal and Torres Strait Islander cultures and knowledges.

*Table 8: Bachelor of Science (Extended) outcome summary*

| Measurable program outcomes | Progress towards outcome | Outcome theme |
|---|---|---|
| Strong student engagement, retention, and results | Effective<br><br>Medium level of evidence | Student attainment, engagement and aspiration |
| Increased student aspiration | Effective<br><br>Medium level of evidence | Student attainment, engagement and aspiration |
| Students successfully transition into Bachelor of Science | Effective<br><br>High level of evidence | Student attainment, engagement and aspiration |
| University building stronger relationship/partnerships with local Aboriginal organisations and communities to increase Aboriginal science knowledge | Effective<br><br>Medium level of evidence | Community and cultural connection |
| Innovative, place-based, culturally responsive science curriculum and pedagogy incorporating Indigenous science knowledge delivered by University of Melbourne academics | Effective<br><br>Medium level of evidence | Culturally responsive STEM education |
| Strong student engagement with development opportunities – study abroad, exchange scholarships, awards, prizes, volunteering, leadership opportunities | Emerging<br><br>Medium level of evidence | Student attainment, engagement and aspiration |
| Aboriginal and/or Torres Strait Islander students succeeding in tertiary education, including graduating from Bachelor of Science (Extended) | Effective<br><br>Medium level of evidence | Student attainment, engagement and aspiration |

# Appendix C: Indigenous STEM Awards

## Program focus

Recognising, rewarding, and celebrating the achievements of Aboriginal and Torres Strait Islander people studying or working in STEM. The awards also celebrated the role of schools, teachers, and mentors. Between 2016-2020, the program recognised the achievements of 44 recipients and 120 finalists.

## Delivery methods

- Award finalists were selected by a panel of professionals from CSIRO, the BHP Foundation and other STEM organisations. Dr Aunty Kaye Price AM was the chair.
- Recipients were given the opportunity to travel to the US to participate in the Intel International Science and Engineering Fair (pre-COVID-19), and were provided personal development opportunities, including media and communications training, and ongoing mentoring.

## Key findings and lessons

- Recognition of individual efforts in STEM had an impact on confidence and motivation and helped to promote their work and the value of Indigenous scientific knowledges.
    - 94% of surveyed recipients agreed that receiving an award contributed to the recognition of their achievements by their community.
    - Some recipients said more could have been done to promote the Awards and achievements more widely.
- Award recipients also indicated the program provided them with new opportunities and connections (e.g. further education, job offers, conference presentations, project funding). This was more so for award recipients than finalists.
- Building awareness of Aboriginal and Torres Strait Islander knowledges in the community, and of the impact award recipients and finalists have on their community.

Note: CSIRO did not complete a full evaluation of the Indigenous STEM Award similar to the other programs.

# Appendix D: $I^2S^2$

## Program focus

Provided professional learning opportunities to Years 5 to 9 science teachers in metropolitan and regional schools, to increase student engagement and achievement in science. The program connected with 513 schools, 548 teachers plus 499 using online Teacher Professional Learning (TPL) and reached 11,375 students.

### Delivery methods

- TPL focused on embedding Aboriginal and Torres Strait Islander scientific knowledges through hands-on inquiry-based projects. TPL was designed to improve teacher understanding and capacity in science inquiry and the diversity of Aboriginal and Torres Strait Islander cultures.
- The TPL was initially delivered through face-to-face sessions, then the TPL was delivered via a blended model of face-to-face sessions and webinars (with ongoing support and resources). Schools worked in clusters to consolidate and collaborate on the learning.
    - The program moved to an entirely online self-paced model because of COVID-19.

### Key findings and lessons

- The program helped to build teacher confidence in applying the new skills, which was bolstered by support from other teachers and schools. Teachers encountered challenges to implementation including:
    - Difficulty finding equipment, materials, time and space to do inquiries.
    - Catering for different levels of achievement and balancing with other curriculum requirements.
    - High teacher turnover, impacting systemic change across schools.
- While online training TPL helped to increase reach, it impacted the confidence gained through face-to-face delivery with specialised local coordinators.
- The inquiry-based learning increased engagement and achievement among Indigenous and non-Indigenous students, with greater impacts seen among ‘low-achieving’ students.
    - For example, the proportion of ‘low-achieving’ students recording a passing grade in science increased from 0% to 42% in 2018 and 34% in 2019.
    - Aboriginal and Torres Strait Islander students who could share their knowledge and culture helped increase their comfort with contributing in the classroom.
- The program had less success with community and parental engagement, with just a few examples of schools involving parents/carers or Elders in learning activities. Building connections was dependent on existing capacity in schools. Schools acknowledged more could be done in this area.

- While $I^2S^2$ schools had higher levels of enrolment in STEM subjects, this could only be determined using data from one jurisdiction and therefore it is difficult to attribute results to the program.

*Table 9: $I^2S^2$ outcome summary*

| Measurable program outcomes | Progress towards outcome | Outcome theme |
|---|---|---|
| Increased teacher capacity in both inquiry and Indigenous contexts | Effective<br><br>Level of evidence not provided | Teacher and school outcomes |
| Increased student engagement and academic results | Transformative<br><br>High level of evidence | Student attainment, engagement and aspiration |
| Increased student aspiration, sense of value, cultural identity, and school belonging | Transformative<br><br>High level of evidence | Student attainment, engagement and aspiration |
| Increased community and parental engagement and schools have increased cultural competency delivering Aboriginal and Torres Strait Islander contextualised inquiries in partnership with families and community | Emerging<br><br>Medium level of evidence | Community and cultural connection |
| Schools supporting other STEM programs (e.g. ASSETS, Creativity in Research, Engineering, Science and Technology, Indigenous STEM Awards, PRIME Futures) | Effective<br><br>Medium level of evidence | Teacher and school outcomes |
| Identification of 'best practice' in high expectations science inquiry education and teacher professional learning, and adoption of this 'best practice' by states and territories. | Effective<br><br>Medium level of evidence | Culturally responsive STEM education |
| Increased number of Indigenous (and non-Indigenous) students pursuing STEM pathways, including in Years 10 to 12, university and alternatives | Effective<br><br>Medium level of evidence | Student attainment, engagement and aspiration |

# Appendix E: Science Pathways for Indigenous Communities

## Program focus

Developing integrated two-way science learning programs with remote schools and communities to connect Indigenous ecological knowledge with Western scientific knowledge. The aim was to support teachers of primary and middle school students to engage with their community to develop education plans and curriculum. The program reached 25 communities, 15 schools, 113 teachers, 77 Aboriginal and Islander Education Officers, and 971 students (predominantly in Western Australia, but also in South Australia and the Northern Territory).

## Delivery methods

- The program was built around on-Country projects developed through partnerships with Elders, ranger groups, scientists, and land management organisations.
- Initially designed to support individual schools, the program shifted to a cluster model of culturally and geographically aligned schools to encourage collaboration on sustainable two-way science programs.
- In response to COVID-19, the program shifted online (Science Pathways Adult Learning Program) providing professional development for school staff and community members. In 2021 the program was expanded to a self-directed online learning to spread the reach and accessibility of the program.
- Science Pathways school communities contributed their knowledge and perspectives to the 'Two-way Science: An integrated learning program for Aboriginal Desert Schools' practical teacher guidebook. The program also produced a series of videos which are hosted on the Australian Curriculum, Assessment and Reporting Authority website.

## Key findings and lessons

- The program helped to build partnerships between schools, parents and local communities which was seen as crucial to the success of two-way science teaching. This included building shared goals for the curriculum, engagement in Learning on Country trips, and creating a more welcoming school environment.
    - Participants did note the practical limitations of taking students on Country (e.g. access to vehicles)
- Teachers had increased capability in undertaking two-way science inquiries in on-Country contexts. Face-to-face support for teachers was critical in building cultural confidence.
    - Easy to use and adapt resources provided through the program were also key to implementing and embedding the approach in schools.
- The program was effective at increasing student engagement, results and aspirations. However, data was limited to teacher perceptions impacting the strength of this evidence. The strongest outcomes were perceived to be engagement and aspirations.

*Table 10: Science Pathways for Indigenous Communities outcome summary*

| Measurable program outcomes | Progress towards outcome | Outcome theme |
|---|---|---|
| Strong, effective partnerships established with schools and other stakeholders | Transformative | Community and cultural connection |
| Increased community and parental engagement | Transformative | Community and cultural connection |
| Increased teacher capacity in two-way science using on-Country contexts and cultural competence | Transformative | Teacher and school outcomes |
| Increased student engagement and attendance | Effective<br><br>Medium level of evidence | Student attainment, engagement and aspiration |
| Increased aspiration and sense of value and school belonging | Effective<br><br>Medium level of evidence | Student attainment, engagement and aspiration |
| Enhanced student results | Effective<br><br>Medium level of evidence | Student attainment, engagement and aspiration |
| The program's two-way science learning approach and resources are culturally responsive, community-based and embedded across school curriculums | Effective | Culturally responsive STEM education |

# Appendix F: Purposeful Rich Indigenous Mathematics Education (PRIME Futures)

## Program focus

Increasing teacher capacity to understand Aboriginal and Torres Strait Islander culture and incorporate it into mathematics lessons from Foundation (Prep) to Year 9. The program worked with teachers in mainstream metropolitan and regional schools with higher-than-average Indigenous student populations. It was delivered to 379 teacher-trainers across 62 schools, reaching 32,317 students (22% Aboriginal and Torres Strait Islander).

## Delivery methods

- The program was delivered by the YuMi Deadly Centre (YDC) at Queensland University of Technology using the YuMi Deadly Maths approach. The Centre closed following completion of the program in 2019.
- The program was a combination of centrally organised professional development and informal school-based activities. YDC provided training to teacher-trainers over 2 years, who trialled the approach in their classroom and then trained other teachers in the school.
- The program as implemented in a staged roll-out across school clusters in Queensland, Western Australia and South Australia.

## Key findings and lessons

- Teacher surveys showed an impact on engagement and achievement. For example, 91% of teachers reported increased student engagement. Teachers reported perceived modest improvements in test results, however, student achievement was difficult to demonstrate as data was not collected.
- Like other programs, PRIME Futures resulted in increased teacher capacity and confidence in new skills. 53% of teachers were using the approach in most or all lessons. However, lower than expected continuous attendance at workshops potentially impacted effectiveness of the program.
    - It is important to note the multiple demands placed on teachers' time, with time spent away from the classroom requiring preparation. This also impacted teacher ability to train other teachers.
    - As a result, the program modified delivery so workshops could stand alone.
- The program was also effective at strengthening connections with parents and Indigenous communities. These partnerships are supported by whole-of-school plans. Many of these schools, however, already had strong community connections.
- The program was less effective at influencing systemic change across the school, noting this type of change needs coordinated effort within and across schools, and buy-in from leadership.

*Table 11: PRIME Futures outcome summary*

| Measurable program outcomes | Progress towards outcome | Outcome theme |
|---|---|---|
| Positive student engagement with new pedagogy | Transformative<br><br>High level of evidence | Student attainment, engagement and aspiration |
| Improved teacher capacity/capability in implementation and delivery of culturally responsive maths pedagogy | Transformative<br><br>High level of evidence | Teacher and school outcomes |
| Schools demonstrating strengthening relationship with parents and local Aboriginal and/or Torrs Strait Islander communities reinforced by comprehensive school plans | Effective<br><br>Medium level of evidence | Community and cultural connection |
| Improved student results | Effective<br><br>Medium level of evidence | Student attainment, engagement and aspiration |
| Increased cohorts of students in Years 10-12 pursuing maths and STEM pathways | Effective<br><br>Medium level of evidence | Student attainment, engagement and aspiration |
| Whole-of-school implementation / delivery of best practice, culturally responsive maths pedagogy | Effective<br><br>Medium level of evidence | Culturally responsive STEM education |