



Queensland University of Technology
Response to Department of Industry, Science and Resources
Diversity in STEM: dialogue starter

Insights have been requested from organisations who support, employ, educate, learn from, represent or have policies and programs impacting people in STEM. These groups include but are not limited to:

- First Nations people
- Culturally and Linguistically Diverse (CALD) people
- women and girls
- people living in regional and remote areas
- people with disability
- people from low socio-economic backgrounds
- neurodiverse people
- LGBTIAQ+ people
- people who face age-based discrimination.

Insights to address:

- Cultural and structural barriers that limit participation and retention of women and other historically underrepresented groups in STEM professions
- Broader program and policy measures to promote and support greater and more nuanced inclusion and diversity in STEM with a focus on people from underrepresented cohorts
- Opportunities to attract, promote, retain and support diverse leadership in the STEM sector.

Questions to start the conversation

1. What does STEM mean to you?

You might like to think about:

- why it is important to you, your field or your organisation to be involved in STEM
- what you are most proud of (in STEM)
- how diversity contributes to why STEM is important to you.

QUT response:

[High school engagement] QUT is dedicated to increasing STEM participation and study in high schools, and building awareness of STEM disciplines with the next generation of university students. For over a decade, QUT has built successful partnerships with schools across metro and regional Queensland, providing a program of individual and multi-school workshops that connects students with inspirational learning experiences on-campus.

Critical to the success of the program is QUT's unique and leading approach to engaging high school students across a wide variety of engagement touchpoints. True impact comes from students having several discipline-related experiences throughout their schooling journey.

Our academics, student ambassadors, graduates and student clubs play a vital role in inspiring high school students about the possibilities of their future. Direct interaction with these role models through hands-on learning opportunities and peer-to-peer mentoring builds student interest in senior subject selection and degree options and curiosity about career pathways.

Our programs have been designed to provide avenues for females and other non-traditional students to network with experts from a range of industries, to build aspirational pathways, and to network with other like-minded students. Our events promote inspiration, engagement and connection, link to real-world scenarios and involve industry expertise for authenticity.

2. What are your stories or perspective of accessing and belonging (or not) in STEM?

You might like to think about:

- any opportunities you wish you had now, in the past or in the future
- if you can provide these opportunities (in the past, present or future), how do they contribute to access and belonging
- how organisations, including yours, have addressed a lack of diversity, including where they have embraced opportunities for change and thrived
- any positive or negative experiences you have had or created within the structures of STEM (meaning institutions, processes, qualifications, etc).

QUT response:

[High school engagement] Self-efficacy and social support are two barriers to young women's interest in and pursuit of STEM activities and careers. STEM activities need to be designed to target female students in activities that promote self-efficacy and positive perceptions of STEM disciplines. There is a strong need to develop long-term sustainable programs that create systemic change in the engagement of young women in STEM disciplines.

QUT's high school programs have been designed to provide avenues for female students to network with experts from a range of industries, to build aspirational pathways, and to network with other like-minded girls. Our events promote inspiration, engagement and connection, link to real-world scenarios and involve industry expertise for authenticity. Feedback from both high school teachers and industry participants highlighted that partnerships between schools, universities and industry are critical in addressing the underrepresentation of women (particularly in STEM careers).

In detail a few of the successful high school initiatives at QUT addressing the gender issue include:

- Power of Engineering Inc is a not-for-profit organisation, formed by QUT, Engineers Australia and AECOM, that aims to inspire non-traditional students, especially females, to consider a career in engineering. QUT events are delivered by female undergraduates from QUT student group, GEMS (Gender Equity in Engineering Makes Sense). The events are designed specifically for female students in Year 9 and 10, and their teachers, and are timed prior to senior subject selection. An integral part of the program is the industry site experience, exposing students to career journeys of female engineer role models who provide a positive real-world context to the engineering profession. The program has achieved outstanding support from industry stakeholders, offering student experiences that aim to raise girls' confidence and their families' and teachers' expectations through showcasing non-stereotypical careers and female role models. Since the first event in March 2012, QUT has delivered 40 events (Brisbane, Caboolture, Cairns, Dalby, Kingaroy) with 5,357 students participating in the program.

In engineering, the participation of women in a bachelors degree has trended steadily up, by nearly 1% per year. In 2023 QUT saw the proportions of women increase from 18.08% to 22.72%, QUT's highest female percentage on record.

- Since 2020, QUT has been offering opportunities for female students entering Year 12, a two-week intensive delivery of a first-year unit. The intensive first-year unit is offered through our Start QUT program, which includes university academic credit on successful completion of the unit. In a safe and supportive environment, the two-week block of learning will cover the unit assessment, receiving progressive feedback on students practical exercises, further investigation research and project plans.

This program is an affirmative action to address the current gender imbalance in STEM professions nationally and is in response to Industry demand for women in this field.

- Anecdotal feedback from high school teachers and students suggests that undertaking a Start QUT unit in a standard semester can be a difficult juggle for high performing students who are also balancing other high school studies.
- Research on women in STEM initiatives suggests that early experiences in a girls only environment can build girls' confidence and self-efficacy in studying STEM subjects (removing stereotype threat, for example).

We have seen positive impact from this program, with 44% of students who completed the IT unit, enrol in a technology based degree. Since 2019, our IT female student intake has increased from 9.91% to 19.42%.

- The annual Future You STEM Summit program, has 59% female participation, and includes 30+ industry speakers, 50+ STEM researchers and 20+ undergraduate mentors. QUT integrated entrepreneurship principles into this program to increase self-efficacy and aspiration to a STEM career. By providing entrepreneurial pathways for creative problem solving, this was more appealing to female students considering or yet to consider a STEM career.

3. How can we fix the unacknowledged assumptions, including unconscious biases, of our STEM system?

You might like to think about:

- who you think is seen as the 'typical' STEM worker – What do they do? What do they look like? What is their background?
- what you think is seen as the 'typical' STEM organisation – What do they do? What do they look like? Who leads them?
- who do you think has the power or control when it comes to designing or participating in STEM education, STEM programs and the STEM workforce
- how we can help shift this culture
- what you are most afraid of if we don't solve this challenge
- what the most pressing need is
- what this review can do to help.

QUT response:

[QUT High School Engagement] There is no single bullet, and that universities, schools, industry and parents all play a part in boosting numbers of diversity in STEM.

- Suggest an improved understanding of student's motivations to study STEM vs student's who chose humanities degree/career, to inform guiding strategies for increasing participation.
- Strongly suggest that specific strategies are implemented to attract students to one discipline i.e. engineering, rather than promoting STEM as an aggregated field.

A recent QUT survey of first year undergraduate students found that parents and subject area teachers strongly influence a students' decision to pursue their chosen degree.

- More effort needs to be made in improving influencers understanding and awareness of the STEM related study and career options available to their current and future students, plus an appreciation of the students' capability and potential and ability to pursue a STEM career.

4. Have you had experience with existing measures or programs (government funded or not) aimed at improving the diversity of Australia's STEM system?

You might like to think about:

- whether your experience was positive or negative
- what need, barrier or opportunity the program/s seek to address
- how this contributes to systemic or cultural change
- how you would improve the effectiveness of these programs.

QUT surveyed staff, high school students, teachers and university students to provide insights on this question.

Think of the best STEM experience you have been involved in. List three things that made it special.

The broad themes that emerge when analysing the university student, teacher and staff data:

- Collaboration with others was very important in creating a positive STEM experience. Students benefited when there was a “sense of camaraderie”, when they “felt included” and were all working together to achieve a goal. Genuine collaboration helped build that sense of community which was critical in making the most of the experience.
- The role of the teacher/educator is key. Many responses focussed on the importance of the enthusiastic and engaged delivery of the session/content by knowledgeable teachers.
- Students enjoy the hard work. They get satisfaction from the challenge that STEM presents in learning new things, and enjoy the sense of satisfaction achieved seeing the outcome of their hard work.
- Teachers commented that the experiences need to be practical/hands on and recognise the importance of linking learning to real life examples.

The broad themes that emerge when analysing the high school student data:

- Many comments focused on the need to provide interactive, hands-on STEM-related engagement activities, that encourage collaboration, competitiveness and learning new things.
- Students commented that exposure to STEM experts (student ambassadors, industry professionals, researchers) as an authentic preview of university life and study and careers was important.
- Teamwork and collaboration was considered to be very important in fostering an interest in pursuing a STEM career. Working in small groups, encourages students to share ideas, problem solve and gain different perspectives.
- Competitions where students engage in problem-solving scenarios, providing an opportunity to develop a deeper understanding of important mathematics and to exercise STEM recognised skills such as collaboration, problem-solving, creative and critical thinking, and communication (specific mention of the National Science and Engineering Challenge and F1 in Schools Australia).
- Many comments identified primary school activities as an activity that increased their motivation to pursue senior STEM subjects and careers.
- A few responses suggested the provision of activities that explored several STEM disciplines to spark curiosity, awareness and aspiration for senior STEM subjects and careers.

How do you think we should design STEM experiences so that they are appealing for a broad cross-section of our population?

The broad themes that emerge when analysing the university student, teacher and staff data:

- One focussing on ensuring that STEM activities are designed to be fun and interactive. Focus on better visualisation, and ensure that explicit links to real life examples are made to demonstrate the versatility of STEM in everyday life. Giving people the freedom to explore was an interesting example. Free (or low cost) engaging public events was mentioned.
- Another view point held was that STEM activities are already exciting enough, however it is the culture that needs to be addressed. Women leave not because they are interested in the degree but because of the way they are treated. STEM activities should be designed to address this behaviour/culture
- Many comments focussed around the needed for STEM activities to be presented from a more diverse perspective. That this strong representation and diverse leadership that show others that they can do STEM too is equally if not more important than specific diversity activities.
- There was also commentary that we should involve diverse audiences in the conversation about what would inspire them more, and recognition that everyone has different journeys and perspectives. We should listen more rather than just given them what we think they want, which echoes the sentiment of this project I guess.

The broad themes that emerge when analysing the high school student data:

- There is strong commentary on the provision of practical, hands on activities, that bring the mathematics and science curriculum to life. To really resonate with students, STEM activities

should clearly demonstrate how concepts translate into the real-world. Students want to connect what they are learning with a practical application.

- Many comments again focussed on the need for incentivised competitions, that allow students to collaborate with their peers in a fun and engaging way.
- Strong views on ensuring all young people, regardless of background, distance or cost, can participate in activities to know about the STEM fields and the career opportunities open to them.
- Offering activities that teach students future-focussed technology i.e. robotics and coding. 3D printing

Describe one way that you think we can make STEM experiences more appealing for all members of our society.

The broad themes that emerge when analysing the university student, teacher and staff data:

- Strong themes around promoting diversity in STEM, highlighting successful examples (historical or current) of women or diverse people who have had interesting careers in STEM, thereby breaking down traditional stereotypes. Connected to this is the importance of teachers/role models who instil the message that girls can do anything.
- There is very strong commentary that we need to show women (explicitly) how they can have both a career and be a mother
- Some sad commentary focussed on the need to ensure all spaces are equal, inclusive and safe. (eg. “need to stamp out misogyny from the top down. senior women are still experiencing discrimination and it is shocking to see that it has become worse and not better with time”; “As a young women having been in this industry for 6 years, I don't have any confidence or hope anymore for things to get better. I don't think they ever will and I carry the burden of being concerned for the safety of other younger women around me.”

The broad themes that emerge when analysing the high school student data:

- Strong commentary on the importance of providing access to STEM expertise not typically available to them and their schools.
- Offer activities that allow students to identify as a future STEM professional with an increased motivation to pursue STEM at a tertiary level. Ensure you foster relatable, desirable and achievable diversity in STEM career identities.
- Making STEM more visible to the public and building community awareness of the benefits and the role STEM professionals play in society.
- One view point, was to ensure that parents have a better understanding of the various STEM related study and career options available to their children