



# Australian Summit on Gender and STEM: Rethinking an issue that refuses to resolve

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# Australian Summit on Gender and STEM: Rethinking an issue that refuses to resolve

## Why was a summit needed?

Despite decades of research, investment and policy development, the issue of gender and STEM engagement remains intractable. The problem of participation in STEM is deeply complex and involves multiple influences that often constitute barriers to equitable participation in STEM. The STEM communities have had a focus on girls in STEM in particular across these decades leading to interventions at a number of levels including curricular and pedagogical responses, careers advice, the use of role models, special events and single sex classes. Thus far, however, the intractability of the issue is evident in the little substantive change that has occurred.

## The summit

This summit brought together national experts on this topic from across the different levels of education, industry and government for one day with the aim of engaging critically and making progress on this longstanding issue.

The Summit aimed to move discussion and action on the issue of gender and STEM forward through an exploration of recent theorisations of gender to interrogate the gender and STEM issue. In doing so, the Summit considered new perspectives that we hope will inform a shift forward in gender equitable theorising and approaches to STEM education.

### Objectives of the event

1. To explore current research, debates and frameworks in terms of gender disparities within STEM fields.
2. To examine current policies and practice to shape a way forward.
3. To explore intervention initiatives and strategies for upscaling.

In this paper we present an analysis of the presentations and discussions during the day, organised by themes.

## Theme 1: Framings of Gender and STEM

Gender in relation to STEM requires a more nuanced appreciation of the constructed and intersectional nature of gender.

The issue of gendered participation in STEM has long been framed in a way that creates a binary between girls and boys. This approach is increasingly recognised as oversimplifying the concept of gender and failing to acknowledge the complexity of gendered relations with STEM.

A major outcome of the summit was recognition that discussions of gender and STEM need to take a more nuanced view on gender; one that moves beyond considering this as a binary issue of girls versus boys to recognise that gender is diverse both in what it means to be a girl and that the issue also affects those in the LGBTIQ+ community. There is also a need to consider how issues of gender intersect with other influences on how people engage in STEM. Gendered patterns of participation in STEM vary significantly based on parental level of education, parents' own engagement with STEM, socioeconomic status (SES) and sociocultural background, and rural versus metropolitan context.

STEM itself is not uniform; gendered participation varies across the STEM disciplines and stages of education or career. Physics, mathematics and engineering remain the disciplines with the most problematic disparities in girls' participation in schooling, tertiary education and beyond, potentially differentially blocking career options. However, even in disciplines where gender disparity does not appear in schooling or where girls successfully negotiate disciplinary gendered barrier in earlier education, these often become a problem as people progress through their career.

Gender, as opposed to biological sex, is increasingly recognised as a social construct, meaning that individuals learn to enact gender according to socially agreed-upon rules and behaviours. These expectations of gendered behaviour can conflict with what has been normalised in particular STEM disciplines, presenting a problem.

Issues of girls feeling they don't belong in fields like physics, computer science and engineering are well-documented. Many STEM disciplines have been described as having a classroom and workplace culture consistent with traditional notions of masculinity. Such cultures are perpetuated by students, teachers and those in the STEM workforce through rewarding more traditional masculine sensibilities and behaviours. As a result, they can be antagonistic toward girls and others who do not feel they align with such cultures, leading to feelings of not belonging and ultimately not pursuing careers in these areas. Traditional notions of masculinity also negatively affect the way boys pursue careers in STEM fields that are perceived to be more caring and feminine such as the health professions.

A further strong theme at the summit was a critique of the framing of the gender and STEM 'issue' exclusively in labour market terms. This framing of the issue was criticised at the summit as too narrow as it does not appropriately take into account the benefit of STEM literacy for all in a world where STEM is omnipresent and necessary to navigate complex information and misinformation. As with gendered effects in STEM workforce participation, STEM literacy is intersectional in affecting different societal groups differently.

## Theme 2: Cultural and Structural Barriers and Challenges

Structural barriers within institutions and society more broadly operate across lifelong STEM experiences to obstruct possibilities of equitable participation in STEM. Rectifying these structural relations should be a key consideration at all levels.

Structural barriers are obstacles that affect one social group disproportionately and result in disparities. Such barriers are deeply entrenched in the operations of many social institutions, particularly including education and workplaces, and are shaped by societal norms and expectations. For gender, traditional structural barriers include socially prescribed rules and expectations about the behaviours, interests and abilities of women and men as well as associated conceptions of masculinity and femininity. These barriers work to create and maintain gender inequality in social structures. Individuals, institutions and society are engaged in the production and reproduction of these gendered norms, attitudes and stereotypes.

Participation in STEM at all levels is hindered by structural barriers stemming from gendered stereotypes and cultural habits maintained within STEM communities and society at large. These gendered norms are perpetuated from early childhood through to the highest level of many institutions: from young children enforcing

traditional gendered behaviour to the normalised gendered language and behaviour in boardrooms that result in gendered gatekeeping and maintenance of traditional gendered roles. As young people begin to learn about STEM, gendered expectations of teachers and parents, often in the form of unconscious bias, also work to frame and reinforce gendered discourse. Examining and monitoring normalised gendered discourses and norms in educational and organisational environments is thus central to ensuring that structural barriers are questioned and broken down in order to establish equitable gendered opportunities.

It is important to acknowledge the complexity of tackling gender issues considering the intricate nature of human relations and societal dynamics. The interaction between different levels of society (family, community, workplace, government, religion, portrayals of STEM) and educational institutions (early childhood settings, schools, TAFE, and universities) contribute to the complex and layered structural nature of gender issues within STEM in terms of policy, discourse and practices across these diverse settings.

## Theme 3: The need for initiatives to span the social, structural and individual levels

To have success, initiatives aimed at addressing gendered participation in STEM require a collective effort across social, structural and individual levels.

### Structures as a lever

For a long time, the majority of approaches that aimed to address girls' and women's underrepresentation in STEM have focussed on the individual. The summit made clear that the issue with this approach is that given how rooted structural inequities are in institutions, including early childhood settings, schools, universities and workplaces, any focus should not primarily be on 'strengthening' girls, women and LGBTIQ+ individuals. Instead, what is required is a collective effort across all levels where the focus is on scrutinising and shifting embedded, inequitable institutional norms and practices and the wider cultural presumptions and practices that nourish these.



In workplaces, some success in this has been achieved through initiatives focused on ensuring, through a variety of means, a shift in the gender balance in positions of power, influencing discourse and promoting different versions of merit, particularly in male dominated fields. In such fields, a critical mass of women, LGBTIQ+ people and other minorities in decision-making rooms is critical for disrupting traditional power discourses. Inroads to challenging male dominance in academia have been achieved through measures such as recruitment and shortlist targets, Gender Action Plans and funding for women-only professorships. The Athena Swan program that has been taken up by a number of organisations internationally and in particular in Australian universities has led to structural and policy changes being put in place as a means to invigorate cultural change. In workplaces, training focused on changing gender-based language and biases have also resulted in some change.

A parallel set of initiatives to these measures is the gathering and promulgation of an evidence base concerning gender disparities. One example is a key research project by the Office of Women in STEM Ambassador involving the analysis of awarded grants by gender over a 20-year period alongside a study on the impact of anonymising research applications for scientific equipment. The analysis reveals gender disparities in grant distribution, emphasising the importance of addressing workplace gender disparities to drive change. Similarly, a 2024 report from the Chief Scientist has found that research metrics that are commonly used in universities penalise women and favour older males. Another is the 'STEM equity monitor' put together by the Australian Government which offers a first step to identify patterns and gaps in STEM.

Beyond these initiatives, structural issues around gender participation in STEM industries need to involve broader regulatory interventions such as tax structure changes to support shared parental responsibility and leave, part-time work and affordable childcare access and career structures recognising family commitments. Such initiatives require broad cultural shifts and political support.

Programs and initiatives that have tried to address structural issues of gender in relation to STEM across early childhood and schooling appear to be rare. While there have been initiatives over the last decade that are trying to address structural issues in universities and the workplace, there has been less focus on addressing this at earlier stages. Instead, here, initiatives tend to largely focus on the individual.

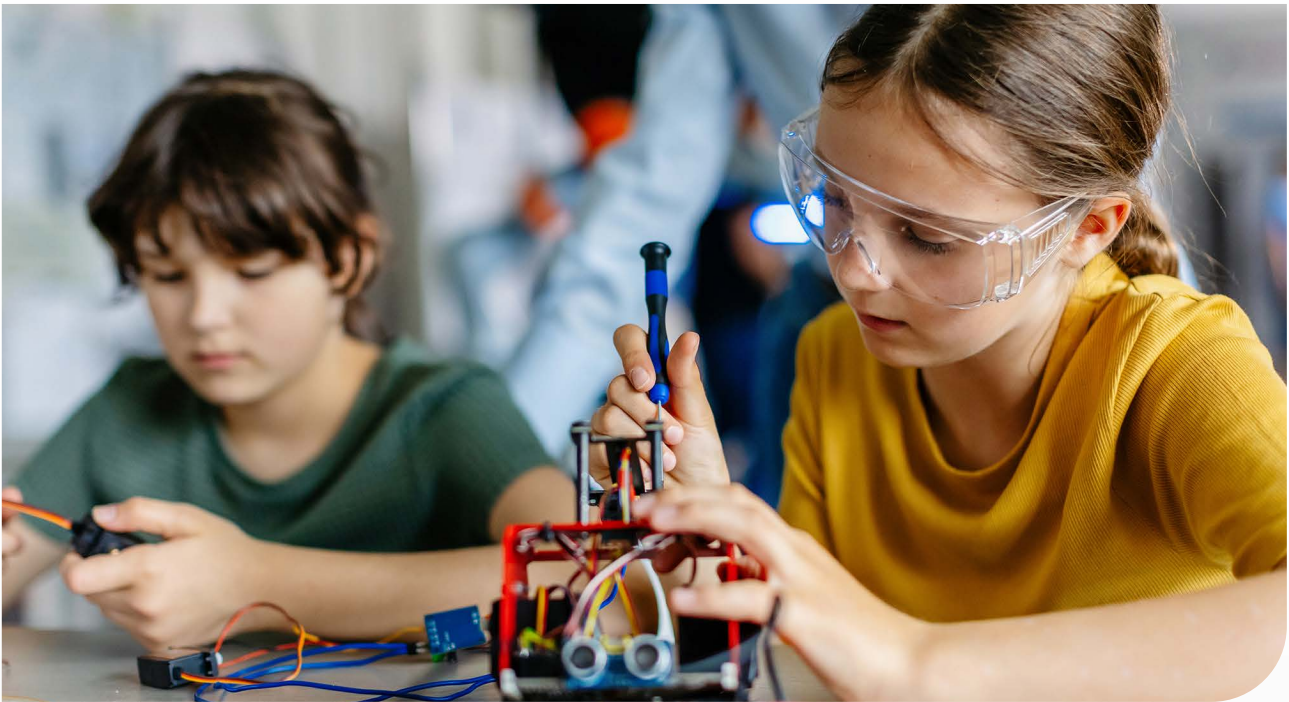
There has been a range of initiatives aimed at individual girls in Years 9 and 10 as this has traditionally been the time at which they choose their senior secondary subjects. However, we know that in reality programs need to commence at a much younger age, reflecting where gendered stereotypes are first established. Even here, such programs generally do not address broader structural issues. While there have been some structural changes to STEM curricula in an attempt to make them more inclusive, these changes have had mixed success and have been criticised by some scientists, educators and researchers as playing into traditional gender biases.

The summit brought into stark light the difference in how the issue is addressed at different levels of education, the need for a more connected effort across stages and the need for a greater focus on underlying structural barriers to gendered participation in STEM from early childhood on. The structural issues associated with gendered disparities in STEM across formal schooling have been conceptualised as involving gendered disciplinary discourses that frame the perceptions of teachers, family, curricula and students, operating through broader cultural framings. Professional learning programs around gender-based language and biases would be beneficial for early childhood educators and centres, schools and initial teacher education. Such training can work to change the culture of STEM and should also work toward establishing more nuanced gender perspectives including wider conceptions of masculinity. Given the interplay between parents, teachers and education governance structures, this requires a broad approach that is driven by departments of education and early childhood and school leaders.

## Community as a driver of transformation

As noted above, programs aimed at addressing gender in STEM have traditionally focussed on individuals through programs such as mentoring or taking girls out of the classroom to engage them with STEM-related activities. Along with challenging the traditional structural barriers that are outlined above, there is still a need to empower a more diverse group of young people and adults through ready access to initiatives that provide the opportunity for those individuals to challenge assumptions and expectations that are based on gender especially while structural barriers remain. Such opportunities work to empower girls, women and those in the LGBTIQ+ community to develop agency and voice and to continue to push boundaries.

To enhance this individually-focused work, there is a need to recognise the value of exposure to positive, communal STEM experiences. Recent research has shown the importance of people feeling that they fit and belong in STEM in order for them to pursue STEM further. The development of a positive identification with STEM is a strongly social one and the community of people that individuals come into contact with both within formal programs and in more casual settings play an important role. STEM has traditionally been framed as individualistic, but this does not allow for recognition of how exposure to positive, communal STEM experiences is incredibly valuable.



An example of a program that takes a community approach is Deakin University's Girls As Leaders in STEM (GALS) Program (funded by The Invergowie Foundation), which gives school aged girls the space and permission to construct themselves as doers, users and leaders of STEM. Importantly, the program also provides the impetus for others in their schools and communities to celebrate their success, therefore normalising the agentic STEM 'girl' within their community. Also, the problems that girls choose to solve are diverse, challenging traditional disciplinary cultural framings of STEM subjects and achievement to recognise the usefulness and personal gratification that collaborating within a STEM space can bring.

Aimed at working scientists, another program that raises awareness, community and communication amongst women is the 'Superstars of STEM', which has led to an amplifying of the conversation about gender issues. These kinds of strategies focus on empowering women through increasing the visibility of diverse STEM career possibilities.

## In conclusion

While there have been decades of work undertaken around gender and STEM, this summit sought new perspectives and ways forward on this seemingly intractable issue.

The three themes above attempt to capture the major shifts that are needed to make progress. Gendered participation in STEM needs to be recognised as a more nuanced issue than simply relative participation of boys versus girls in STEM education and workplaces. There are significant intersectional, cultural and structural issues that underpin gender-related inequities that need to be tackled. Achieving a major transformation of gender inequality in STEM demands multi-level, multi-stakeholder collaboration between levels of education, workplaces, policymakers, and the community, including parents.

It is hoped that future initiatives and programs take the following recommendations into account.



## Recommendations

1. Initiatives and programs need to recognise that gender is not binary and that experiences of and participation in STEM are intersectional.
2. The narrative around why we need people to engage with STEM needs to broaden to capture why STEM is beneficial beyond a narrow focus on career pathways.
3. Programs and initiatives need to include multi-level, multi-stakeholder collaboration across levels of education, policymakers and the community, including parents and carers.

### Raising awareness and changing practice in early childhood and schooling.

4. Initial teacher education needs to explicitly address gender in STEM in educational settings. This includes a focus on the structural bases for gender bias, gendered positioning, assumptions and intersectionality.
5. System-wide government funded initiatives need to be created during schooling and early childhood that specifically focus on challenging gender-based language (for educators) and safe and supportive spaces for collaboration and normalising STEM aspirations and achievement.
6. Current early childhood educators, schoolteachers and STEM leaders need to be engaged in programs and professional learning that exemplify and develop critical perspectives on gender and STEM empowering them to address gender in their education settings.
7. Initiatives that address structural barriers need to be implemented across the education spectrum to support structural and cultural change.

### Raising awareness and changing practice in tertiary education and into the workforce.

8. Renewed government initiatives and policies are needed that support women and LGBTIQ+ to remain in the STEM workforce.
9. Initiatives aimed at addressing gender and STEM need to include the LGBTIQ+ community.
10. Initiatives need to address the intersectional nature of gender and STEM, and support people from diverse sociocultural and socioeconomic setting.

### Future research areas.

11. Research that closely follows intersectional influences on engagement and participation in STEM in Australia.
12. Research that explores how structural barriers are best addressed from early childhood education onward.
13. Research that attends to the hidden gender bias of teachers across the STEM disciplines.
14. Research that systematically explores the influence of initiatives on people's relationship with STEM.



## List of Speakers<sup>1</sup>

- 1 – Associate Professor Victoria Millar: Faculty of Education, University of Melbourne.
- 2 – Professor Helen Watt: Director of Research Development (Social Sciences), Professor of Educational Psychology, University of Sydney; FASSA.
- 3 – Professor Kathryn Scantlebury: Emerita Professor, University of Delaware. Honorary Professorial Fellow, University of Melbourne. Executive Board Member, Gender & Education Association.
- 4 – Mr Phil Cairns: PhD candidate and Queer Officer, Monash Graduate Association, Monash University.
- 5 – Deakin Distinguished Professor and Professor of Education Jill Blackmore AM: Deakin University; FASSA.
- 6 – Dr Marguerite Evans-Galea AM: Director, Cell and Gene Catalyst, AusBiotech
- 7 – Dr Isabelle Kinglsey: Senior Research Associate for the Office of the Women in STEM Ambassador, University of New South Wales.
- 8 – Dr Janin Bredehoeft: Chief Executive Officer, Science in Australia Gender Equity (SAGE).
- 9 – Professor Kylie Smith: Professor Early Childhood Studies, Faculty of Education, University of Melbourne.
- 10 – Professor Linda Hobbs: Associate Head of School, Research, Deakin University.
- 11 – Associate Professor Merryn McKinnon: Centre for the Public Awareness of Science, Australian National University.

## List of Organisers and Editorial Team

- 1 – Associate Professor Victoria Millar: Associate Professor of Science Education, Faculty of Education, University of Melbourne.
- 2 – Dr Lihua Xu: Senior Lecturer, Education (Science Education), Deakin University.
- 3 – Professor Linda Hobbs: Associate Head of School, Research, Deakin University.
- 4 – Professor Russell Tytler: Deakin Distinguished Professor and Chair in Science Education, Deakin University.
- 5 – Professor Jan van Driel: Professor of Science Education, Faculty of Education, University of Melbourne.
- 6 – Dr Adam Masri: Research Fellow and casual academic, School of Education (Science education), Deakin University.



<sup>1</sup> Speakers are arranged based on the order of their presentation during the event.