



THE UNIVERSITY OF
MELBOURNE



Women in STEM Decadal Plan

Submission to public consultation

18 October 2018

Executive Summary

The University of Melbourne welcomes the opportunity to submit to the consultation that will inform the development of a Women in STEM Decadal Plan by the Australian Academy of Science and the Australian Academy of Technology and Engineering.

The Discussion Paper aptly maps out the STEM-specific and broader social barriers that affect women's participation, retention and success in education and employment. The Discussion Paper accurately summarises some of the specific challenges facing the tertiary sector in addressing the under-representation of women in STEM. Despite widespread awareness of the gender gap, the pace of change in STEM¹ fields has been too slow. A national approach articulating a shared 10-year vision will assist all stakeholders to combat generational under-representation through leadership, cooperation, and calibrated and coordinated interventions.

As new technologies and knowledge-based industries transform society and business it is crucial that no-one is excluded from contributing their expertise, creativity and potential. As one of the University's leading female engineers, Associate Dean Professor Elaine Wong, has asked, 'how can we solve the complex problems that society throws at us when we don't have a diverse cohort of people addressing these problems from every conceivable angle?'.²

While the University is proud to have many outstanding female students, staff and alumni making a difference in STEM fields,³ we are aware of the continuing systemic challenges that prevent a more even gender representation and are acting to address them within our sphere of influence.

Gender equity and representation is a key focus of the University's *Diversity and Inclusion Implementation Plan and People Strategy 2015-2020*. This strategy and others underpin the University's commitment to accelerating the representation of women in academic, professional and leadership roles within the Professoriate, STEM faculties and University leadership.

The University recognises that the issues do not start at the point of entry to higher education and has implemented outreach programs to encourage female participation in STEM education at secondary and tertiary levels. Institutionally, the University has supported initiatives aimed at increasing representation, retention and leadership opportunities in research and academia.

The University is also a pilot institution in the Science in Australia Gender Equity (SAGE) Athena SWAN initiative, which aims to advance gender equity in academia, address gender gaps and remove obstacles facing women. The University is committed at the highest level to continuing participation in this program and achievement of its aims.

Measures implemented thus far have had positive outcomes, which demonstrate the importance of scaling up efforts to achieve more significant and timely results.

In addition to work that business and public institutions can do to remove the gender gap, suggested initiatives to include in the ten-year Road Map for Australian Government action include:

¹ This response slightly broadens the sectors of interest to include medicine (STEMM) on the basis that women in medicine and biomedical fields can face similar barriers to those in STEM, particularly in relation to senior appointments.

² Professor Elaine Wong, [Gender diversity & the Melbourne School of Engineering: IWD2018](#)

³ <https://discover.unimelb.edu.au/stem>

- Increase investment in effective STEMM-based opportunities and exposure to encourage girls in primary and secondary school to participate in STEMM disciplines, and allied teacher education;
- Measures encouraging and where feasible requiring employers to offer workplace flexibility which, while it will benefit both men and women, specifically addresses some of the challenges women face in career progression;
- Supports to help women overcome career interruption, including amendments to grant agency guidelines for assessing applications;
- Incentives for STEMM employers to utilise high-impact corrective initiatives (such as female-only recruitment) to attract leaders and role models into STEMM research and industries where gender gaps are entrenched; and
- A focus on evidence-based change, with the collection of data supporting the evaluation of initiatives and as measure of progress.

These are encapsulated in the following recommendations.

Recommendations

1. The Australian Government should continue to support and expand the Science in Australia Gender Equity (SAGE) Athena SWAN program.
2. The Australian Government should expand supports and opportunities for female academic secondment to industry particularly at post-doctorate and at mid-career level.
3. The Australian Government should work with universities, schools and State and Territory Governments to invest in and support large-scale expansion of school-based or external programs that help girls and young women gain competence and confidence in STEMM.
4. The Australian Government should offer a HELP fee waiver to teaching degree entrants who specialise in STEMM subjects to boost the supply of STEMM competent teachers in primary and secondary schools. Teacher education directed towards addressing cultural and systemic barriers to girls' participation in STEMM should be supported.
5. The Australian Government's Road Map on women in STEMM should demonstrate leadership by identifying and reducing structural barriers that inhibit women from remaining in STEMM work, including by celebrating the outstanding achievements of women in STEMM.
6. The Australian Government should work with universities and national research funding schemes to clarify and promote the existing application of 'performance relative to opportunity' considerations in grant and fellowship assessments, including collaborating on educative process aimed at applicants and assessors.
7. The Australian Government should continue to deliver and support programs to encourage initiatives aimed at enhancing girls' and women's participation in STEMM. As part of the Road Map, and to assess future progress, a baseline should be established against which the success of initiatives can be assessed.

8. As well as targeted STEMM initiatives, the Australian Government's Road Map on women in STEMM should give momentum to structural transformations that would fundamentally impact women's working lives, such as greater flexibility of working arrangements and parental leave; pay equity; and new funding to support return-to-work and career interruption grants.
9. The Australian Government should take a leading role in raising awareness of the importance of supporting women to senior roles in STEMM through its relevant agencies' policies and practices, including through continuing programs that promote and encourage diversity in leadership, reward change, engage men as key allies and champions, and support public reporting of progress.
10. The Road Map on women in STEMM should leverage and amplify the capabilities of key sectors to support the growth of women in STEMM, particularly at critical junctures such as early educational STEMM engagement, entry to employment, and transition to senior roles.

The impact of universities' and other employers' efforts can be amplified by well-aligned policy settings, well-targeted investment, appropriately resourced programs and strategic interventions at the national level. Concurrently, the University recognises the need to continue efforts at the institutional level to remove barriers and improve gender ratios across our own professional and academic workforce.

For more information, please contact Professor Julie McLeod, Pro Vice-Chancellor (Research Capability) on j.mcleod@unimelb.edu.au or 03 8344 4447.

Women in STEMM at The University of Melbourne

In broad terms, the University is demonstrably an attractive and supportive environment for female students, academics and professionals. Women comprise 67% of the University of Melbourne's professional staff, and 50% of academic staff. Women who apply for promotions at the middle to senior academic levels are more likely to be promoted, with success rates of 81% compared to the male success rate of 66%. Across all faculties and promotions, female applicants have a higher rate of success than male applicants.

The University offers supports to all staff aimed at reducing the impact of career interruptions, such as a return-to-work bonus for employees transitioning from maternity leave; flexible work arrangements including home-based work; and parenting/breast-feeding rooms around campus. We have made changes to sabbatical leave to allow staff greater flexibility. The University also offers shared parental or adoption leave when both parents are employees; four weeks of personal/carer's leave; and onsite childcare in three (soon to be five) long day care centres that can be accessed by staff and students, amongst other entitlements.

Many of our leading researchers, educators and professional staff are women. The University is proud to have four female ARC Laureate Fellows, who are outstanding role models for women in research, both within the institution and nationally.⁴ The University is home to 55,000 students from Australia and around the world, the majority of whom (55%) are female.

⁴ Professor Leann Tilley (Georgina Sweet Laureate Fellow); Professor Joy Damousi; Professor Adrienne Stone (ARC Kathleen Fitzpatrick Laureate Fellow); and Professor Anne Orford (ARC Kathleen Fitzpatrick Laureate Fellow).

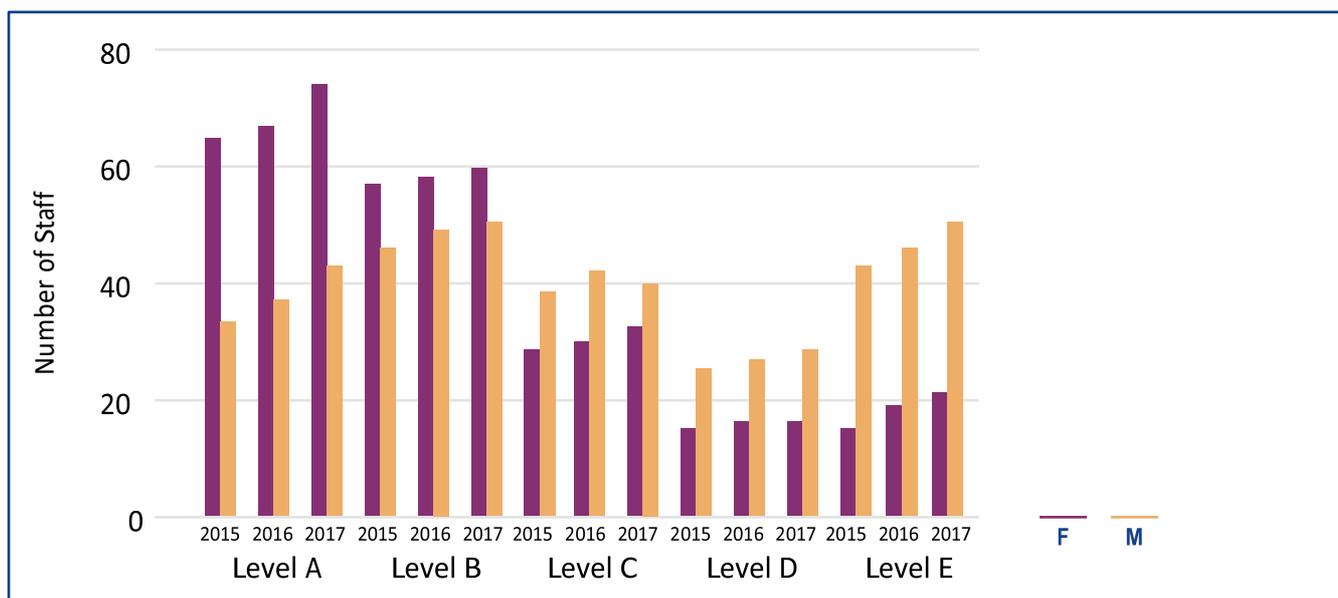
Identifying challenges

We are a comprehensive, research-intensive University with a world-leading biomedical precinct on our campus and strengths in STEMM disciplines. The drive for research excellence influences our academic workforce and shapes performance expectations, giving rise to specific challenges. The increasingly competitive research environment, nationally and internationally, adds another layer of pressure and difficulty. Qualitative surveys amongst academic staff have revealed the view that high performance is commonly demonstrated by rankings, prestige and research income. These outcomes often translate into long hours, continuous research progress and individual performance metrics, all of which combine to disadvantage women due to career interruptions and balancing working life pressures.

Of our ten faculties, four are classified as STEMM and six are Humanities and Social Sciences (HASS). While STEMM staff are broadly 50/50 by gender, disparity is evident at more senior levels. At the earliest academic levels A and B (Tutors, Senior Tutors and Lecturers), women outnumber men across all fields in STEMM and HASS faculties alike. However, this gender distribution is reversed by Level C (Senior Lecturer). By Level E (Professor) men significantly outnumber women.

While there has been an increase in numbers of women at levels C and E over the last three years due to organisation-level commitment to gender equity and recruitment initiatives, the 2017 data still shows more women at the lower end of the scale and more men at the senior end (see Figure 4B).

Figure 4B: Gender distribution by academic level A-E for UoM (2015-2017)



Comparing STEMM and HASS faculties, it is apparent that women's senior representation is much higher in HASS faculties, where the percentage of women holding professoriate positions is 41% compared to 23% in STEMM fields. In disciplines where there is a minority female workforce, such as Mathematics and Engineering, the percentage of top professorial positions held by women is very low at 8-9%. This data reinforces the need for determined institutional efforts to improve gender equity concurrently with the coordinated support of government and other stakeholders.

Initiatives at the University

Career progression

The University has implemented a number of initiatives to support the empowerment and career progression of female academic and professional staff. These include:

Academic Women in Leadership (AWiL): A flagship scheme to support academic women into leadership, including six months of structured activities, shadowing of senior women and men, and small group work on areas of strategic focus for the university under the guidance of a senior sponsor. Currently this program prioritises intake from academic levels C and D.

Mentoring programs: The University, through its Human Resources function, supports formal and informal mentoring engagements. It also runs workshops for early career academics; a Research Mentors Program; and structured faculty programs. While these are not exclusively for women, individual programs can be tailored to support female advancement in STEMM disciplines.

Women in Tech (WiT) student club: WiT is a not-for-profit student club that aims to provide support, opportunities, events and networking for female University students undertaking IT related studies, as well as outreach projects to encourage secondary students to consider technology and computer science studies.

Support for career progression: The University provides support to professional and academic staff to assist in career progression, including skills and graduate certificates for early career academics and sessional academics; qualifications and leadership training for mid-senior academics; and programs in research commercialisation, mentoring and PhD supervision. Again, these benefit all staff, but have particular value for women who experience structural and cultural barriers to participation.

Improving the participation of women and girls in STEMM

The University also supports outreach programs dedicated to improving the participation of young women and girls in STEMM. Examples include:

Girl Power in STEM: A multi-year program that starts with a free, residential program available to 30 female Year 9 students annually, supporting them to attend a camp in the July school holidays to learn about careers in STEMM and form a network of like-minded individuals. In Year 10, the cohort of participants complete work experience at the University, and through Years 11-12 they receive mentoring from University engineering and mathematics students.

ChooseMaths: A joint initiative between the Australian Mathematics Institute (AMSI) and the BHP Billiton Foundation, the ChooseMaths program works with students, parents and teachers over five years to turn around community attitudes and perceptions of mathematics.

Science Gallery: One of only eight Science Gallery nodes worldwide, the new Science Gallery embedded at the University of Melbourne engages 15-25-year-olds in a collision of science and art. Its programs have included a particular focus on encouraging young women's participation in STEMM.

Action Plan for the University

Through its participation in Athena SWAN and in alignment with our *Diversity and Inclusion Strategy* and *People Strategy*, the University has approved a five-point Action Plan on gender equity.⁵ These actions include:

- Setting organisational targets for women in senior academic roles;
Providing more career continuity support pre-, during and post- career breaks;
- Promoting diversity in recruitment;
- Promoting an inclusive LGBTIQ+ ally network; and
- Developing an institutional accountability framework.

The Athena SWAN program is a key plank in driving change and is one of the foremost ways the Australian Government can support, monitor and drive the advancement of gender equity in STEM workplaces.

Recommendation 1: The Australian Government should continue to support and expand the Science in Australia Gender Equity (SAGE) Athena SWAN program.

In advancing the Action Plan and other institutional gender equity initiatives, the University is cognizant that male staff members (academic and professional) are an integral part of the change process as supporters, active participants and leaders. Male colleagues can be strongly positive role models with direct power to influence and lead change; this is particularly true in faculties, laboratories or professional areas with entrenched male-majority leadership.

The initiatives outlined and supported throughout this submission, such as unconscious-bias training, female-only recruitment and improved promotions and grants assessment processes, require sustained and visible support, and active participation or leadership, from all men and women working in universities.

⁵Beyond the Action Plan, the University is working in other areas to promote gender equity and appropriately support all staff and students. The University's *Diversity and Inclusion Strategy* has the LGBTIQ+ community as one of its priority groups. We are striving to better understand the challenges, opportunities and impacts of our programs and practices. As also noted in the Discussion Paper, the University is cognizant of intersectionality. We are developing an implementation plan that focuses on understanding and enhancing inclusivity for people from priority groups: gender; Indigenous; LGBTIQ+; disability; and cultural diversity.

CONSULTATION QUESTIONS

1. What changes need to occur to enable more girls and women to participate in STEM education at any level (primary, secondary or tertiary)?

Signal career pathways and create opportunities to stay and succeed in STEMM

At the tertiary education level, there is strong female representation in sciences, social sciences and medicine in student populations and early academia, but there are challenges in retaining and supporting women to senior roles. The pipeline of female students entering and succeeding in STEMM is crucial to the long-term ecosystem of participation, to ensure consistently proportionate gender representation and role models across all major career points.

Maintaining and growing female participation in STEMM industries will require clear career pathways and evidence of jobs that welcome and reward women at all stages of their lives. This is the case for both academic and industry/applied knowledge sector positions. Young women contemplating a life-long career in STEMM are looking for reliable evidence of a good career and/or fair access to research grant funding and senior academic roles. They are also looking at typical factors that are not confined to STEMM, such as fair pay; cultural fit and workplace satisfaction; and equal opportunity for employment and promotion, including in the context of life circumstances such as parenting or caring.

Women's familiarity with, and greater presence within, STEMM industries, particularly at leadership levels, will support cultural change, offering role models and greater opportunity for mentoring. It will also diversify the skills base and leadership potential of academics returning to research from industry. In this regard the Australian Government is well-positioned to set the agenda, bring together key stakeholders and promote cost-effective programs, such as grants for industry secondments or fellowships aimed at postdoctoral women and senior women researchers. Injecting new research-based skills into industry would align with the aims of the National Innovation and Science Agenda.

Recommendation 2: The Australian Government should expand supports and opportunities for female academic secondment to industry particularly at post-doctorate and at mid-career level.

Communication and role models

Universities, in partnership with Government and schools, can better communicate information and options to young women who are entering tertiary education about growing employment areas that require STEMM skills in the medium to long term. Similarly, institutions can positively influence women's choices by implementing programs to address gender imbalances to ensure there are diverse role models at all levels of academia.

High visibility of diverse female role models can fundamentally shift how STEMM subjects are viewed by female students. Universities, in coordination with their networks of secondary schools, are strongly placed to demonstrate the value of STEMM to young women and girls. This can be achieved through maintaining and/or scaling up:

- Guest speakers, career advisors and careers events at secondary schools that present relatable role models students;
- Programs that offer projects for students involving STEMM skills, enabling them to personally experience the useful, practical, tangible and hands-on aspects of work in these fields;
- Programs to address the deficit of skilled STEMM discipline teaching staff in Victorian schools, as teachers are crucial role models;
- Programs in teacher education that increase teacher sensitivity to structural and cultural barriers to girls' participation and equips them with skills and knowledge to address them in the classroom.

Early education can change attitudes about STEMM

At tertiary level education, female under-representation is most pronounced in the fields of mathematics, engineering, physics and chemistry. Corrective and encouraging practices need to start in primary school and continue through secondary school. The development of early positive attitudes towards STEMM topics amongst girls is vital to maintaining female participation and achievement in STEMM fields in the longer run.

Research supports the importance of developing positive attitudes to STEMM from early education onwards. It is well-understood that interest in a subject is related to perceived competence and self-efficacy, which in turn affects confidence. Attitudes, and constructs of self, have repeatedly been found to be associated with mathematics performance and achievement. High mathematics self-concept and high self-efficacy are positively associated with performance (J. Lee, 2009), while high mathematics anxiety is negatively related to performance (Ashcraft & Moore, 2009).

Gender differences in attitudes towards mathematics can explain gender variation in mathematics achievement. For instance, it has been shown that the gender gap in mathematics performance disappeared once factors such as mathematics self-efficacy and mathematics anxiety were included in regression models (Cheema & Galluzzo, 2013).

Practices that would promote positive attitudes and offset traditional gender disparities at early education, primary and secondary level include:

- Removal of subtly gendered messages from classrooms, such as ensuring maths problems tackled in class and questions in texts books have both female and male protagonists, and providing gender neutral play in early education;
- Avoidance of prohibitive gender norms in children's early education, by avoiding educational approaches and materials that reinforce outdated ideas of gender-specific careers;
- Expansion of programs targeted at female primary and secondary students that address confidence and competence in STEMM;
- Support for outreach programs that link secondary students with exposure and knowledge about the real and appealing prospects of STEMM careers; and

- Expansion of targeted programs for staff in primary and secondary schools, as teachers and career advisors are critical in motivating or discouraging students to choose careers, interests, topics and subjects.

The University acknowledges that Australian, State and Territory Governments have been investing in STEM activities at schools for a long time. Existing strategies may need to be refreshed by linkage with campaigns to build community support and change perceptions at the grassroots, and with increased investment in early childhood education to ensure teachers are equipped with relevant knowledge and skills. Australian employers and businesses need to be in the solution. This point is covered in more detail at Recommendation 10 in this submission.

Recommendation 3: The Australian Government should work with universities, schools and State and Territory Governments to invest in and support large-scale expansion of school-based or external programs that help girls and young women gain competence and confidence in STEM.

Build the capacity of STEM teachers in all schools

A research report by the University of Melbourne with Deakin University found that the participation rates of girls in STEM education, particularly in physics and advanced mathematics, have remained unchanged or declined since the mid-1990s.⁶ A persistent shortage of specialist or appropriately skilled secondary maths and science teachers in the Australian education workforce is thought to be one of the key factors contributing to this situation, along with other factors such as home and community influence, media and public portrayals, and early learning environments.⁷

The shortage of STEM teachers was highlighted in May 2018 by the Australian Government's announcement of measures to ensure the presence of at least one science or mathematics-trained teacher in every Australian secondary school.

The University affirms the significant benefits of having STEM-trained teachers in all primary and particularly secondary schools. Our Melbourne School of Graduate Education (MSG) strives to ensure a high standard of teaching candidate competency by requiring applicants to complete an additional Teacher Capability Assessment Tool, on top of the nationally required Literacy and Numeracy Test, which evaluates whether applicants possess qualities and motivations necessary for effective teaching. Universities that provide teacher training also have a direct opportunity to encourage secondary teaching candidates to consider STEM as one of their two subject focus areas. Additionally, the University of Melbourne is one of few to require VCE or ENTER level maths as an entry requirement for our Bachelor of Science, which is a common first degree for our Masters of Teaching cohorts.

Some States and Territories require teaching entrants to have a previous degree or a full year of academic study in the area they will teach. In jurisdictions such as Victoria that take a generalist approach to primary and secondary teacher training, ensuring the availability and capability of STEM teachers is as much a challenge for continuing professional development as for initial teacher education. While there are many benefits to recruiting a teacher with a STEM degree, it is also important that teachers teaching STEM can teach in a way that engages all students, considering background or gender where appropriate. For instance, research has shown that teaching STEM content with gender-sensitive pedagogy, more open-ended questions and real-world applications –

⁶ Hobbs, L., Jakab, C., Millar, V., Prain, V., Redman, C., Speldewinde., Tytler, R., & van Driel, J. *Girls' Future - Our Future. The Invergowrie Foundation STEM Report*, 2017.

⁷ Professor Stephen Dingham, *Why is it so hard to recruit good maths and science teachers?* *The Conversation*, 8 March 2016.

as opposed to single answer questions in an abstracted scenario – is particularly effective in engaging female secondary students.⁸

With targeted training and leadership, teachers can build their STEM capacity and develop a mixed repertoire of approaches to successfully reach a diverse range of students. The University's MSGE is involved in good example of this, the Primary Maths and Science Specialists Initiative. A Victorian Government-funded program, the initiative upskills primary teachers in public schools to become mathematics or science education specialists. Each participating school selects two teachers to undergo 20 days of intensive professional learning delivered by experts in maths, science or STEM education. By building the collaborative expertise of the specialists, who go on to upskill their colleagues through structured coaching and other means, the initiative strengthens and diversifies STEM teaching expertise in the school generally.

The Australian Government should continue to work with State and Territory Governments to identify the most effective incentives for attracting more teacher candidates with STEM competence, particularly girls', and encouraging higher quality STEM teaching skills through scaled-up and strategic professional development as discussed above. An option within the Australian Government's policy remit to boost numbers of STEM-trained teacher candidates over the medium term is to trial the impact of offering a HELP debt waiver for teaching graduates who specialise in STEM.

Recommendation 4: The Australian Government should offer a HELP fee waiver to teaching degree entrants who specialise in STEM subjects to boost the supply of STEM competent teachers in primary and secondary schools. Teacher education directed towards addressing cultural and systemic barriers to girls' participation in STEM should be supported.

2. What are the most effective things we can do to change inaccurate stereotypes about STEM professionals and the range of STEM careers?

Stereotyping has negative impacts in workplace relations and workforce cultures, education pathways and recruitment scenarios. Stereotypes about the demographics of STEM professionals and nature of STEM careers are broadly misrepresentative. But they persist, in part, because they reflect some elements of truth. Perceptions that certain fields are a predominantly male domain are difficult to counter if women are hardly present or are not readily visible as leading success stories.

While it is important to persistently tackle and counteract inaccurate stereotypes where they arise, it is equally important to remove the structural gender inequality that persists across the workforce, particularly in STEM, as it serves to reinforce stereotypes. While negative stereotypes held by men and women of women's characteristics are a barrier, so too are negative stereotypes of STEM workplaces and careers held by women. Job insecurity, relatively low salary, limited career supports or flexibility, lack of job options outside academia, and male-dominated leadership within STEM persist as career realities in some fields. These deterrents, while present to varying degrees in other fields, are well-evidenced across the sector and underpin the gender disparities that allow the cycle of stereotyping to continue.

⁸ Hobbs et al, *Our Girls' – Our Future*, pp 14-15.

A combination of measures to engage and promote women and measures to combat the circulation of negative stereotypes within a workplace environment would help to counter deterrents that compel women to leave STEMM. A mix of measures could include the following (non-exhaustive) suggestions:

- Government should lead by example in celebration of high-achieving women in STEMM, giving them high visibility as role models;
- Institutions and employers should provide comprehensive unconscious bias training and establish institutional protocols that improve workplace diversity in recruitment and promotion;
- Employers (public and private) should consider using female-only recruitment or appointment quotas where it is necessary to achieve a swift and substantial boost to women's representation (discussed further below); and
- Employers should develop and support mentoring arrangements that support women's career trajectories and, importantly, involve high-achieving male employees too.

Recommendation 5: The Australian Government's Road Map on women in STEMM should demonstrate leadership by identifying and reducing structural barriers that inhibit women from remaining in STEMM work, including by celebrating the outstanding achievements of women in STEMM.

3. What measures should we be using to determine eligibility for career recognition and progression?

At the University of Melbourne promotions applications made by female academics have a higher success rate than those of male academics. However, female academics are numerically fewer in the pool of applicants for academic promotion. Women are particularly under-represented in applications for mid-level promotion from Level C to Level D, e.g. women comprise 45% of academics at Level C but only 38% of promotions applicants.

The deep impacts of career interruption and the application format itself contribute to the gender gap. Promotion applications are lengthy, self-driven and arduous in preparation – many women working part-time are unwilling to spend weeks on applications that lack strong and clear chances of success. Applications require extensive peer review and numerous national or international referees. These come from building and maintaining professional relationships through project or research collaboration, travel to conferences and persistent networking, which are all difficult to maintain during significant career interruptions such as parental leave, disability care or caring for a relative. The fast pace of the scientific field can make it difficult to keep up throughout the challenge of transitioning back to part-time work with dependents or relatives requiring care.

Further demonstrating the impact of career interruption on women, university data shows that women are much more likely to apply for a promotion with a *performance relative to opportunity* case as part of the assessment process. They are very likely (85% in 2017) to succeed with such applications.

Clarity and education on performance relative to opportunity in research funding

Career recognition and progression processes in all STEM fields and industries should feature evaluation frameworks that capture the broader impact and achievements of applicants. In the academic sector, Performance Relative to Opportunity (PRO)⁹ is an evaluation measure that seeks to supplement, but not replace, traditional metrics of achievement (quantity, rate or breadth of outputs, such as publications) as the latter imply a vast time component incompatible with career interruptions like child rearing, caring for a disabled relative, or working in a different industry.

PRO calculates achievements in context of the available time in which they were achieved by the applicant, bringing nuance and context that goes some way towards equalising the playing field for applicants who have had time away from work. In doing so, PRO does not displace merit or disciplinary standards, but gives context to the qualities of achievement pertinent to promotion eligibility within institutions or disciplines, such as the University of Melbourne's core performance dimensions of activity, engagement, and quality and impact.

In the University's experience, the availability of PRO as a factor in promotion applications is a game-changing one. National research funding schemes such as the Australian Research Council (ARC) and National Health and Medical Research Council (NHMRC) also recognise and apply research opportunity and performance evaluation as a consideration in assessment of grant and fellowship applications. The University acknowledges the intention demonstrated therein to ensure people are not inadvertently disadvantaged due to personal circumstances.

However, greater clarity, guidance and education on how PRO is calibrated in research grant assessment and how it applies in different academic contexts or disciplines is needed. Qualitative feedback on PRO at the University has revealed that participants hold a variety of perceptions on the efficacy and use of PRO guidelines in grant assessment and promotions, including some concerns about the impact of PRO on applicants' demonstration of merit.

To build confidence and clarity about the use of PRO guidelines, national research councils and research institutions should collaborate on an educative process aimed at evaluators and applicants to ensure the sector is consistently and primarily considering PRO in grant assessments, selection committees and promotion processes. Outcomes to be gained from a collaborative educative process would be:

- (Research schemes' responsibility) Greater knowledge amongst evaluators of how to approach PRO/ROPE, with scenario-based training and examples specific to disciplines; and
- (Universities' responsibility) Improved education for applicants and faculties on aspects of making a case for PRO/ROPE.

Recommendation 6: The Australian Government should work with universities and national research funding schemes to clarify and promote the existing application of 'performance relative to opportunity' considerations in grant and fellowship assessments, including collaborating on educative process aimed at applicants and assessors.

⁹ Also known as Research Opportunity and Performance Evidence (ROPE).

Big picture achievements for promotion at Universities

In the academic domain, factors that actively disadvantage women who are working part-time – such as numbers of times speaking at international conferences and other measures of global recognition – should be deprioritised in promotions assessment. A more team-based assessment process that looks at the overall meritorious contributions made should replace the highly individualised approach, to better reflect the diversity of career phases and skill-sets.

Additionally, career progression processes in STEMM fields should take account of broader social contributions. For instance, scholars who participate in mentoring and sponsoring of student and early career researchers, especially those from under-represented groups, are making a significant contribution to growing the pool of skilled STEMM workers available to academia and industry. Currently, women are more likely to volunteer or be assigned as participants in these activities which are time consuming and less individualistic. Likewise, community engagement and participation on steering /strategic committees that positively impact the scientific or broader population should have greater weight in promotion evaluation.

Institutions such as Universities should ensure recruitment teams across faculties and centres are updating their promotion assessment practices to bring in the bigger picture of applicants' contribution.

4. Australia has more than 330 different initiatives to foster the participation of girls and women in STEM. What type of initiatives are demonstrating the most impact in your area of interest?

The Mapping Paper on STEM participation initiatives for girls and women provides useful insights into the delivery, audience and nature of existing STEMM initiatives across Australia. Many of the initiatives highlighted and recommended by the University's response are captured in Figure 4 as current initiatives, e.g. mentoring, outreach and camps, career progression programs and work experience.

Noting this, the University recommends a ten-year Road Map that scales up government, institutions' and industry support of these proven initiatives (where relevant to remit or jurisdiction) to enhance impact and pace of change:

- Mentoring relationships are a crucial plank in building a strong, supportive community around women in STEMM. While organically formed relationships are often strongest, structured mentoring programs has a key role to play in giving psychological and strategic career support, information sharing and opening opportunities.
- As covered in other parts of this response, outreach from industry leaders to tertiary students and secondary students has attracted positive feedback in the University's experience.
- Industry exposure at various points in STEMM girls' and woman's education and early career is a crucial and under-utilised means of encouraging and informing them about career options.

The University recommends that all interventions to support building STEMM skills – particularly publicly-funded programs – should be designed around a rigorous and science-based platform of evidence. Studies confirming the value of interventions are often not controlled for confounders, lack

controls or baseline measures. The lack of a reliable baseline against which to gauge success means it is difficult to evaluate success or otherwise over time.

Recommendation 7: The Australian Government should continue to deliver and support programs to encourage initiatives aimed at enhancing girls' and women's participation in STEMM. As part of the Road Map, and to assess future progress, a baseline should be established against which the success of initiatives can be assessed.

Female-only recruitment

An important initiative that has achieved positive results in the University's experience is female-only recruitment. Female-only recruitment meets the criteria for 'special measures' under the *Equal Opportunity Act 2010*. It was implemented in 2016 in the University of Melbourne's Mathematics department and has since been repeated in Physics, Chemistry and Engineering. The female-only recruitment drive was viewed as necessary and important due to evidence that the most dramatic drop in women's representation occurred between academic levels B-C, and C-D in those fields especially.

While female-only recruitment is not intended to be a long-term solution, it is proven to have impact lasting beyond the single round of recruitment. By undertaking even one round of female-only recruitment in those departments, the University's data showed *later rounds* of academic recruitment open to both women and men had a far greater proportion of female applicants than prior to the female-only round. Feedback from applicants suggested that the female-only recruitment round sent a signal to applicants that the University supports gender equity and encouraged women to apply to open roles advertised thereafter. Additionally, the quality of applicants to later rounds rose after a female-only round.

The University notes that too few of the initiatives captured in Figure 4 of the Initiative Mapping Document provide flexible supports to women with a career disruption or with responsibilities caring for a young family. Even in employment settings with relatively generous parental leave, such as the University, there are practical barriers to STEMM career progression that persist.

University data demonstrates that compared with professional staff, female academics are far less likely to take up their full entitlement of parental leave due to perceived negative impacts on their career progression and practicalities, such as the pressing need to keep long-term research projects on track. Initiatives to counter this include pre-maternity leave planning as a standard time component, support or replacement for staff on leave, carer's support for short-term academic events or occasional work, and a supportive transitioning return-to-work plan.

5. What societal and regulatory issues (i.e. not STEMM specific) will have the greatest impact on women in STEMM, and how should we address those that are barriers?

Broader societal barriers continue to have a significant impact on the prospects and career trajectories of working women. These barriers – arising from traditional gender norms, conscious and unconscious discrimination and ingrained social bias – are woven into the inherent structure of Australian work and family life. Though policy reforms and social evolution over decades have brought substantial progress, the practical barriers remain.

The experience of women in Australia's workforce would be fundamentally transformed with sustained commitment to policies and programs to deliver:

- Far more instances of men or fathers undertaking primary care of children or care of elderly relatives, including through transformation of government-funded paid leave;
- More affordable childcare near workplaces;
- Flexible hours available to employees in more industries;
- Accountability, transparency and action to close the gender pay gap (in the public and private sectors), and a higher proportion of women in high-earning roles;
- Significant expansion of female role models in senior, professional and public roles, including through quotas and female-only recruitment in circumstances where there is a large and entrenched gap.

Beyond these, the University recommends the Road Map encourage investment and coordination of complementary and enabling measures to assist women employed in specific fields. From the tertiary education and research perspective, measures that would assist women to keep up career momentum and competitiveness include:

- Establishing broader supports for research assistance before, during and after parental leave. This could include providing staff to advance the work while caring for a baby or working part-time;
- Funding as part of national research grants to cover carers' travel for a support person to bring small children with working mothers, particularly in relation to major research conferences;
- Expansion of career interruption funding and fellowships to help mid-career women re-enter their fields with good pace after time away;
- More concerted efforts in all industries public and private to recruit and assess without unconscious bias; and
- (As covered earlier) Clarification of, and education on, 'performance relative to opportunity' in career progression and funding assessments.

There is a significant role for universities to take leadership on some of these measures alongside government. Other efforts are entirely within employers' or institution's remit – such as building awareness and commitment to equal representation on all committees, 'core business' or 'extra-curricular' activities, and committing to scrupulous avoidance of all-male discussion panels.

Recommendation 8: As well as targeted STEMM initiatives, the Australian Government's Road Map on women in STEMM should give momentum to structural transformations that would fundamentally impact women's working lives, such as greater flexibility of working arrangements and parental leave; pay equity; and new funding to support return-to-work and career interruption grants

6. Progress towards gender equity in STEM will require changes. How do we address the challenge of backlash and resistance to these changes?

Building support for affirmative action

Consistent and proactive demonstration of support for changes from the top of organisations is crucial. The University also observes that in many instances, the threat of backlash is overstated. The University's female-only recruitment rounds were initially controversial, but demonstration of the clear need for affirmative action (i.e. the entrenched under-representation evident in the data), and the strong outcomes of the first round (the quality of the appointments), increased acceptance over time.

In general, the strongest argument for initiatives to support STEM women is demonstration of the success of those actions in real terms. This requires effective measurement, including benchmarking, data collection, evidence-based decisions and transparent reporting of progress. Accountability for outcomes must be reinforced through appropriate mechanisms; in the University's case, this is the annual report. Similarly, wherever possible, quantitative data should be used to expose the unconscious bias present in current processes.

The visible engagement and active participation of men in this process is critical. Male allies across workforces and professional levels, including senior leadership, are a fundamental component of achieving successful outcomes. Public champions are critical figureheads and must be held to a high standard. This is also the case for public-spirited institutions such as universities.

Recommendation 9: The Australian Government should take a leading role in raising awareness of the importance of supporting women to senior roles in STEM through its relevant agencies' policies and practices, including through continuing programs that promote and encourage diversity in leadership, reward change, engage men as key allies and champions, and support public reporting of progress.

7. If Australia is to take a strategic approach to improving the participation of girls and women in STEM, where would effort best be placed?

A strategic approach to improving women's STEM participation would coordinate activities across all sectors' areas of influence and direct the greatest share of energy and focus towards critical junctures that 'make or break' the pipeline of participants. Real change will not be achieved without investment, and investment must be adequate to the purpose and targeted.

As well as supporting key initiatives with requisite funds and appropriate timelines to see results, the Road Map should leverage and amplify the capabilities of key sectors to support the growth of women in STEM. There are already multiple entry points into STEM education and jobs from school, VET and university that could be scaled up.

For instance, STEM industries have the market power and reach to attract skilled STEM women and retain them throughout their career. As noted in the Discussion Paper, STEM-based industries

are among the fastest growing in Australia, 'where even a 1% increase in people choosing a STEMM career could contribute over \$57 billion to the economy over 20 years' (p1).

As one of the University's STEMM researchers put it: 'Many women have an interest in STEMM, but STEMM does not appear to have an interest in them. If the future sees a growth in the number of jobs in STEMM, let's define what they are and where they lead to. Then let women know that it is worth considering.'

Government policy through the Road Map should include incentives and requirements that will spur industry leaders and employers to increase their pace and urgency of recruiting and support women in STEMM. This could be achieved through more work placements for tertiary students, mobility schemes between industry and academia, better supports on the employer's side to cover time out of work (for training, caring for disabled dependents, child caring), and organizational participation in a cultural change program. Male and female leaders and middle managers in STEMM industries are crucial to this endeavor, so activities that inform and embolden them to speak up for high-achieving female colleagues are similarly important.

While opportunities exist in a wide range of occupations in the public and private sectors, these roles may require additional specialist (non-scientific) qualifications and experience. There are also systemic barriers to mobility between the academy, public sector and industry including distinct, sometimes 'non-transferable' measures of attainment. A concerted campaign between government, business and academia to open two-way mobility between STEMM education and STEMM industries and change workforce cultures would assist all stakeholders, particularly business, to see value in investing in more diverse employees.

In all sectors, including academia, there should be increased expectation to report a progressively higher ratio of women in senior roles. Visibility of role models has been highlighted at numerous points in this response as one of the crucial factors in attracting and retaining STEMM women. As stated elsewhere, this could be achieved by supporting a range of measures to help women manage career interruptions and adjusting public research funding application processes to better capture performance relative to opportunity.

The Australian Government should also work with State and Territory counterparts to ensure school curricula and programs encourage girls and young women to have unfettered exposure to STEMM as part of gender-neutral learning from the earliest ages. To support this the University endorses the expansion of proactive programs that provide outreach and engagement to primary and secondary students and provide at every school qualified STEMM teachers.

Recommendation 10: The Road Map on women in STEMM should leverage and amplify the capabilities of key sectors to support the growth of women in STEMM, particularly at critical junctures such as early educational STEMM engagement, entry to employment, and transition to senior roles.

8. Is there anything else you have not yet covered in your response which could improve gender equity in STEM?

The Discussion Paper mentioned the impact of male-dominated workplaces and flagged an inquiry into the extent to which sexual harassment causes women to reconsider pursuing a career in STEMM. The University acknowledges disincentives and barriers to STEMM retention including cultural issues

such as unconscious bias, everyday sexism and sexual harassment. The University recognises that conscious or unconscious instances of these incidents can arise in some male-dominated contexts. As such, the professional environment cultivated in a workplace and the quality of the employer's response becomes crucial.

Workplaces, STEMM or otherwise, must adopt zero-tolerance for hostile work environments and make clear that perpetrators of bullying, sexual or gendered harassment will suffer consequences. Similarly, workplaces should implement processes to minimise difficulties experienced by harassment victims and whistleblowers. Through its recently updated *Appropriate Workplace Behaviour Policy* the University provides a mechanism for reporting, investigating and formally responding to inappropriate behavior. There is also an anonymous reporting line to encourage staff who are reluctant to speak out.

The University also offers wellbeing and support services to students. The Safer Community Program (SCP) promotes a respectful, inclusive, and connected campus community that fosters safe learning, working and living at the University. The SCP aligns with numerous actions taken by the University to support student safety, including comprehensive information, training and awareness campaigns, improved reporting and response processes, and greater accountability and transparency.



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