APPLIED

Australian Academy of Technology & Engineering

ACTION STATEMENT
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Enhancing innovation through postgraduate coursework and research degrees in STEM

Australia's innovation agenda needs more postgraduate STEM knowledge and research training

The vision

Australia's future innovation-led economy will have an increasing number of high performing professionals with advanced science, technology, engineering and mathematics (STEM) knowledge, skills and qualifications. These professionals will have the high levels of creativity needed to tackle complex and multidisciplinary problems, and many will take leadership roles in both private and public sectors. Their knowledge and skills will be acquired through undertaking advanced coursework[1], research degrees and work-relevant training.

The increasing demand for graduates from advanced coursework and research higher degree programs in STEM disciplines will come from industry, business and the public sector. The providers of these programs – mostly universities – will devise programs that are responsive and flexible. The programs will include development of advanced transferable and professional skills as well as technical STEM knowledge. Many programs will involve deep collaboration with employers.

The challenge

1. Low numbers of Australians completing postgraduate courses/PhDs in IT and engineering

The national figures for the completion of STEM higher education qualifications in 2016 show that international graduates outnumber Australians in both postgraduate coursework and research categories for information technology (IT) and engineering. Many of the international students that Australia educates to high levels will return home to build their knowledge-based economies. Others may take up employment in Australia – to its advantage.

Having more Australians with advanced STEM qualifications is essential to increasing Australia's capacity for STEM-based innovation. The data in the table below demonstrates the concern that not enough Australian students are doing postgraduate courses or PhDs in IT and engineering.

2. Low translation rates into industry

Australian industry and business will benefit from increased numbers of advanced graduates with skills in priority areas such as artificial intelligence, cybersecurity, biomedical engineering, bioinformatics, and autonomous systems. In the UK, engineering graduates and especially postgraduates provide the social networks, skills and absorptive capacity to not only 'do first-rate engineering,' but also to drive business development more generally[3].

Australian universities' STEM faculties are performing well and much of the universities' STEM research is rated as world-class. This is recognised by the strong numbers of international enrolments in advanced coursework and research degrees.

Award completions from Australian universities in the STEM fields of education areas, 2016[2]

Field of Education: Completions in 2016	Research Degrees**		Postgraduate Coursework		Bachelor (inc Hons)	
	domestic	int'l	domestic	int'l	domestic	int'l
Natural and Physical Sciences (including Mathematics)	1,324	847	1,426	932	16,512	2,522
Information Technology	187	198	1,249	4,050	3,543	2,803
Engineering and Related Technologies	718	883	2,207	3,999	7,741	3,807

1. Advanced coursework means graduate certificate, graduate diploma and masters programs that extend STEM knowledge and skills beyond those of the first degree taken in the discipline. In engineering, the first degree – which qualifies graduates for commencement of supervised professional practice – may be an accredited coursework Masters degree.
2. Australian Government Department of Education and Training (2017), *2016 Award Course Completions, Higher Education Statistics.* https://docs.education.gov.au/documents/2016-award-course-completions
3. Technopolis Group (2015). *Assessing the economic returns of engineering research and postgraduate training in the UK.* https://www.raeng.org.uk/publications/reports/assessing-the-economic-returns-of-engineering-rese

Yet, the benefit of graduate training and the translation of research into Australian industry and business is poorly rated in terms of commercialisation. Advanced coursework and research in Australia should be designed to build capacity for new innovative enterprises, advance the performance of existing enterprises with skilled postgraduate employees, and foster industry-university collaboration.

3. Low numbers of women completing postgraduate STEM studies

Women, on average, graduate from STEM bachelor degrees with higher levels of achievement than their male peers, however women remain a distinct minority in most areas of STEM postgraduate study and research. In particular, they remain as distinct minorities in physical sciences, engineering and IT.

Of additional concern is the decline of women in research-only positions over the 2010-2016 period, given that they are the feeder to higher level academic positions and research as well as role models for future female students.

The way forward

A transformation of current STEM postgraduate coursework and research degrees is imperative to address the challenges of:

1. Low Australian postgraduate student numbers
2. The translation of research/researchers into innovation and industry
3. The participation of women in STEM post-graduate education

The Academy advocates for the following initiatives that will:

Improve the value of postgraduate coursework degrees and research degrees for Australian students by:

» Constructing postgraduate coursework programs as flexible and articulated qualifications (nested modules, graduate certificates, diplomas, and masters degrees), taught in part-time or internship study modes with individual modules and course units offered online through an advanced personal learning system

» Including interdisciplinary and non-STEM content that emphasises the broad context in which specialised STEM work is undertaken. This includes ethics, entrepreneurship, creativity, design thinking, systems thinking, project and IP management, sustainability and business skills

» Linking the defined outcomes of courses with relevant professional education and practice/registration requirements of professional bodies and potential employers

» Adopting best-practice learning approaches that include work- based experience that is assessed against agreed discipline and employment-related learning outcomes

» Ensuring relevance is maintained through regular input and feedback from graduates, industry and employer groups

Ensure that STEM postgraduate coursework and research degrees provide attractive and valuable career pathways by:

» STEM faculties working collaboratively with industry

» Treating research higher degree candidates as career professionals in STEM

» Encouraging industry-based internships and international study

» Encouraging industry mentoring for all doctoral candidates, through the ATSE Industry Mentoring Network in STEMM (IMNIS) project, and other initiatives

» Expanding current professional doctorate models to improve industry's recognition of the value of employees with doctoral skills

» Encouraging recognition by universities of the importance of translation of research and strong industry engagement in postgraduate research degrees

» Supporting the development and incubation of new and innovative STEM-based companies through accelerator programs

Encourage further participation of women in STEM postgraduate degrees, especially in the physical sciences, mathematics, engineering and IT by universities:

» Committing to implement the Science in Australia – Gender Equity (SAGE) initiative post the current pilot program

» In partnership with STEM employers, working to improve the professional environment and prospects of female STEM professionals through, for example, equity and inclusion policies that ensure the success of women in academia and industry

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