ATSE

SUBMISSION TO THE

# Department of Education and Training Optimising STEM Industry–School Partnerships: Inspiring Australia's Next Generation – Issues Paper

FEBRUARY 2018

AUSTRALIAN ACADEMY OF
TECHNOLOGY AND ENGINEERING

# SUBMISSION TO ISSUES PAPER

# OPTIMISING STEM INDUSTRY-SCHOOL PARTNERSHIPS: INSPIRING AUSTRALIA'S NEXT GENERATION

The Australian Academy of Technology and Engineering (ATSE)[1] welcomes the opportunity to provide input into the Australian Government's consultation on optimising STEM-Industry partnerships.

ATSE considers that inspiring Australia's next generation is crucial for the Australian economy to flourish. Critical to the success of this is the need to ensure schools deliver 21st century skills of communication, collaboration and creativity that sit alongside a clear prioritisation of mathematics and science.

The workforce of the future will be fragmented and will combine traditional roles with those emerging in entrepreneurial start-ups. Students and graduates from tertiary education that enter the workforce will need a combination of skills, both the interpersonal skills and deep discipline knowledge to adapt to these opportunities. Effective curriculum design through primary and secondary education delivered by inspirational teachers is critical in ensuring support is provided. Clear direction by industry, both large and small, on future workforce needs is essential to informing and supporting students in relation to post-school education and training.

Key points made in ATSE's submission:

- 21st century skills of communication, collaboration and creativity must sit alongside a clear prioritisation of mathematics, computational thinking and science in school education;
- School students will be inspired to pursue STEM subjects based upon the relevance of science and technology in their lives and exposure to role models, including female role models, profiling a variety of careers;
- teachers need to be equipped with the necessary skills to assist their students to engage with future workforce changes;
- teachers should be appropriately qualified in one or more of the STEM disciplines, and in technology enabled education;
- Industry, *in partnership with schools and universities,* has a clear opportunity to provide work place skills to school students;

1 ATSE advocates for a future in which technological sciences, engineering and innovation contribute significantly to Australia's social, economic and environmental wellbeing. The Academy is empowered in its mission by some 800 Fellows drawn from industry, academia, research institutes and government, who represent the brightest and the best in technological sciences and engineering in Australia. The Academy provides robust, independent and trusted evidence-based advice on technological issues of national importance. ATSE fosters national and international collaboration and encourages technology transfer for economic, social and environmental benefit. www.atse.org.au

- Industry should provide STEM teachers with an opportunity for professional development by spending time in the workplace to understand how STEM subjects are applied in practice.
- standardisation of process and offering in school-industry partnerships is critical to students having comparable opportunities/experiences;
- programs that relate to the students' career aspirations and raise their awareness of the wide range of potential career paths that build on subjects such as physics, mathematics, computational thinking and chemistry are essential;
- uniformity in partnership programs, with parameters that capture knowledge gained, as well as skills and capabilities of creativity and collaboration will provide good data for measuring outcomes;
- Outcomes of these key points or recommendations should be measured for excellence and effectiveness. Examples are:
    - students being inspired and encouraged in entrepreneurial activities;
    - an increase in uptake of STEM based subjects;
    - an increase in students taking the more challenging STEM subjects
    - girls being engaged in careers with a strong STEM focus;
    - *all students* having a foundation level of digital literacy, computational thinking and mathematics to year 12;
    - strong industry involvement in identifying and providing exposure to 21st century workplace skills;
    - Strong industry involvement in the professional development of teachers.
- Any program or initiative should consider the sustainability of the program as part of the design

ATSE supports the provisional recommendations in the Issues Paper and provides some supporting information and perspectives, drawing upon the expertise and input of the Academy's Fellows - some of Australia's most eminent experts in technology and engineering across industry, government and academia.

**STEM in Education and Work**

Within the context of 21st century skills and knowledge, there will remain a critical need for deep technical knowledge. It is essential that deep discipline knowledge is not displaced but should instead be positioned to benefit from broadening with skills such as communication, collaboration and creativity alongside the discipline knowledge.

The importance, excitement and relevance of STEM need to be positioned for students as early as primary school to later attract those students to the studies requiring critical thinking in the STEM domains. Students should be acknowledged and rewarded for selecting advanced mathematics and science subjects, and the ATAR system should be adjusted accordingly (just as is currently done for languages). Universities should reinforce the importance of the challenging mathematics and science subjects by requiring these as prerequisites.

To broaden the appeal of STEM subjects throughout school, their portrayal is critical; siloed subjects may be replaced with interdisciplinary subjects. ATSE's STELR program engages students in STEM subjects by appealing to the student's appreciation of the relevance of

science in their lives, which can often be under appreciated despite living in an engineered world, and surrounded by the outcomes of science and technology[2]. The program aligns with the national curriculum and is an activity-based, interdisciplinary approach to STEM using equipment designed to increase the fun and effectiveness of hands-on activities. The program aligns STELR modules with the high level of concern the majority of students have about global warming and climate change. Students work with concepts such as renewable energy and sustainable housing. ATSE is pursuing methods to ensure the STELR program is available in all secondary and primary schools in Australia. There is a clear role for industry to support this rollout.

Further, the Academy's STELR Women in STEM and Engineering (WISE) project is targeted at engaging all students, and in particular inspiring girls (outlined below), demonstrating that STEM messaging can be tailored to individuals and groups to increase interest and understanding.

**The Role of Industry**

Industry, defined broadly, needs to play a role in training both technical and 21st century skills, linking with schools, universities and vocational training to provide inspiration and opportunity

Many STEM skills require an element of apprentice style learning and workplaces of different sized industries can contribute to that throughout the education system, such as internships/work experience, or through workshops on school premises such as the She Flies program[3].

To accommodate the scale of work experience opportunities for all students, onus could be placed on both schools and industries located within a local area in the first instance, or a wider area if certain skills are sought. This would assist schools to engage with the diversity of STEM offerings from industry and start-ups. Incentives could be provided to encourage participation and to ensure employers are supporting the development of workplace skills.

In addition to scale, the standardisation of process is critical so students have comparable opportunities/experiences.

Guidance should be provided to employers in large, medium and small enterprises to:

- develop a meaningful and diverse program for each student (to avoid exposure to only menial tasks)
- assign a supervisor; and
- coordinate teacher visits.

Of importance is to recognise the potential conflict of interest for businesses and other organisations contributing to the education system and narratives around STEM. Existing

2 STELR has ensured all its industry career material which is embedded in the STER modules and lessons have gender balance, further, STELR has a good representation of take up in girls only schools and there are a number of learnings from STELR regarding the engagement of both girls and boys in science and maths.

3 https://sheflies.com.au/

biases, inequality and under-representation also need to be kept in check and not inadvertently presented as normal when industry participates in education initiatives.

### Teacher Professional Development

Prerequisite knowledge of basic STEM concepts will increasingly be required by students to enable engagement in future education and training.

It is critically important that teachers are equipped with the necessary skills in STEM in the context of a changing workforce. As such, an increased focus on STEM based studies and discipline specific professional development should combine with efforts to ensure teachers are appropriately STEM qualified.

Evidence highlights the influence of inspirational teachers in a student's decision to progress with STEM studies. A report from the Australian Council of Learned Academies has found that countries that lead on STEM education and workforce skills have inspirational teachers who are well trained in a STEM discipline and in pedagogy. This can be achieved by ensuring teacher training includes a bachelor's degree with a relevant STEM major, combined with post-graduate teacher training qualifications[4]. The Academy has highlighted the importance of having discipline-trained teachers in its policy Action Statement *World leading STEM teachers for Australia*[5] which is attached to this submission.

Allowing teachers to spend time in industry would empower them to understand how STEM subjects are applied in practice, allowing them to convey this information passionately and authentically to their students when they return to the school system. Teachers could spend 6 - 12 months in an appropriate organisation (SMEs would be an excellent choice in this case), with their salary being subsidised in whole or in part by the department of education. While not identical, such a program could be structured along the same lines as the following CSIRO program (https://www.csiro.au/en/Do-business/Solutions-for-SMEs/Our-Funding-programs/STEM-Plus-Business).

### Solving Real-World Problems – Careers Awareness

Programs that raise the awareness of potential career paths for students to ensure subjects such as physics, maths and chemistry are relatable to students' career aspirations is essential. ATSE is engaged in two projects that seek to encourage students to pursue STEM studies.

The ATSE STELR project is underpinned by the guiding principal that motivating students to pursue a STEM education requires raising their awareness about the valuable, real world applications of STEM and how their classroom learning is related.

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4 Australian Council of Learned Academies, Securing Australia's Future, STEM: Country Comparisons; International comparisons of science, technology, engineering and mathematics (STEM) education, May 2013

5 ATSE, World leading STEM teachers for Australia, December 2015

ATSE STELR through a Women in STEM and Entrepreneurship initiative, is producing a video series aimed towards engaging the interest of secondary school students, particularly girls, presenting short career profiles of up to 20 inspiring women, with varied experiences in STEM and Entrepreneurship and at different stages of their careers from across Australia.

Each video will feature an authentic voice, showcasing the individuality of their career journeys, the opportunities and life experiences they have gained from their STEM education.

The following (draft) video provides a clear example of a career pathway that grew from a foundation of maths into applying those maths skills in a real world, digitally enabled role.

The WISE video series will be supported by curriculum materials and classroom activities that will be developed to relate directly to the Australian Curriculum in Science, Maths, Work Studies, Business and Economics and Cross Curriculum Priorities. General capabilities will be highlighted.

- a new STELR resource exploring the nature of STEM and entrepreneurial skills and behaviours, challenges and opportunities, through the WISE career profiles, their work and experiences, mapped to the Work Studies curriculum
- case studies exploring their work, innovations, research or projects accompanied by worksheets and/or activities and each will be integrated into existing STELR resources, as appropriate depending on topic
- questions and activities for each video to highlight the important messages to students and to focus their thinking

A teacher guide will also be produced with an overview of the content and suggestions for use in the classroom, links to the curriculum, as well as providing additional resources and reference material.

**Outcomes and Impact**

ATSE considers that excellent outcomes/impact would be:

- students being inspired and encouraged in entrepreneurial activities;
- an increase in uptake of STEM based subjects including Yr 11-12 computing, engineering and design subjects offered in all states/territories;
- an increase in students taking the more challenging STEM subjects
- girls being engaged in careers with a strong STEM focus;
- *all students* having a foundation level of digital literacy and a mathematics to year 12; and
- strong industry involvement in identifying and providing exposure to workplace skills.

Students must be stretched in their science and mathematics subjects and inspired to do so by understanding where these can lead by hearing stories such as ATSE's WISE videos; industry coming into the classroom; ATSE's STELR program and work experience with industry.

Equitable access to programs will be important, digital programs that rely on internet access need to recognise some barriers to this.

Measurement of this will be made easier by uniformity in programs, with parameters that acknowledge both hard data of courses completed and scores to capture knowledge, and measurement of skills and capabilities of creativity and collaboration. Career paths may assist with this, in which case the proposed unique student identifier will be beneficial.

Members of ATSE's Education Forum are available should further information be required. The relevant contact at ATSE is Janine Rayner, ATSE Senior Policy Analyst, at janine.rayner@atse.org.au or 03 9864 0909.