Australian Catholic University

Optimising STEM industry-school partnerships

Submission to the STEM Partnerships Forum

February 2018

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Summary

Australian Catholic University (ACU) is pleased to respond to *Optimising STEM industry-school partnerships*, the issues paper released by the STEM Partnerships Forum. ACU strongly supports the central aim of the Forum's current work: to ensure that 'all of our youth have basic science and mathematics competencies', and that sufficient numbers of students enter STEM-based careers.[1]

This submission provides the University's perspective on STEM industry-school partnerships, with a particular emphasis on two areas:

- STEM in Education and Work (Chapter 1); and
- Teacher Professional Development (Chapter 3).

In summary, the key messages in the submission are that:

1. **Prerequisites for entry** into STEM courses at university are important, for both the individual student and the university.

2. **Schools must enable their students** to gain the necessary prerequisites for STEM courses at universities, by lifting participation and success rates in STEM subjects. This may require more work to address misconceptions about STEM among primary and secondary students.

3. **School teachers need the confidence and knowledge** to teach STEM subjects and/or to explain the importance of STEM to students seeking career guidance.

4. Universities like ACU are in a strong position to work along **a broad span of the STEM education spectrum**: to produce STEM-literate teachers; and to benefit from their work in the classroom by then recruiting the next generation of STEM students to university.

5. There is no quick-fix and this work takes time - but we should **take action now** and monitor results.

We note the Provisional Recommendations in the issues paper, and provide comment on some of them in this submission. We also make the following recommendations of our own:

Recommendation 1: That the STEM Partnerships Forum raise with the Minister for Education and Training the impact of higher education funding cuts on STEM enrolments, in an effort to seek a timely solution to the problem.

Recommendation 2: That universities balance access to STEM courses with the provision of support for student learning, to ensure that students not subject to STEM prerequisites have every opportunity for success.

Recommendation 3: That a formal program be established to offer teachers STEM secondments, for the purpose of upgrading their subject knowledge and professional capacities over a period of 6-12 months. Host organisations could include, for example, CSIRO, Google and Tesla.

[1] STEM Partnerships Forum (2017). *Optimising STEM industry-school partnerships*. Canberra: Department of Education and Training, p. 4.

Recommendation 4: That the subject specialisation requirement currently being implemented for new primary teachers be applied to the entire primary teacher workforce, with an emphasis on STEM specialisation.

Recommendation 5: That teachers be allocated more time for subject-specific professional development, by transferring non-core tasks to support staff (namely, para-professional staff and final-year teaching students working as paid interns).

ACU and STEM education

ACU occupies an influential position in science education, due to its status as the educator of the greatest number of new teachers in Australia – including teachers who will deliver STEM education in primary and secondary schools. The University also delivers further education and professional development to the existing teacher workforce, making it an important service provider throughout a teacher's career.

In addition to initial teacher education (ITE), ACU delivers a range of courses in the Faculty of Health Sciences, and educates more nurses than any other university in Australia. A large number of our students undertake units in science, as part of their Health Sciences degrees.

STEM EDUCATION AND CUTS TO UNIVERSITY FUNDING

Universities make every effort to serve industry and the broader community, through teaching, research and workforce development – but they operate within a funding environment that can change with little warning. The university funding cuts announced by the Federal Government on 18 December 2017 placed into immediate jeopardy enrolments in STEM courses. Due to the structure of funding for student places, universities now face a perverse incentive to concentrate their enrolments in courses that are cheaper to deliver, such as business, commerce and law. If universities choose to maintain (or increase) their 2017 enrolment levels in STEM courses, they face a significant financial penalty. [2]

ACU has been directly affected by the funding cuts. Before the cuts were announced, ACU increased its offers in the Faculty of Health Sciences for 2018 by 20 per cent, in response to the level of demand from industry and the community. However, as a result of the funding cuts, every one of ACU's enrolments in a range of new Allied Health and STEM courses will be unfunded. This includes all new enrolments to the Bachelor of Science, across all campuses. Every university in Australia is currently faced with the same dilemma concerning STEM enrolments, with very troubling implications for STEM education.

Recommendation 1: That the STEM Partnerships Forum raise with the Minister for Education and Training the impact of funding cuts on STEM enrolments, in an effort to seek a timely solution to the problem.

The issues paper

The issues paper rightly emphasises the crucial role of universities and other tertiary education institutions in 'the STEM education pipeline', noting that they have 'the expertise required to help schools communicate important messages about STEM to [school] students and teachers'.[3] The following section of the submission responds directly to

[2] The amount of funding delivered to universities for each Commonwealth Supported Place (CSP) is differentiated by funding cluster: students of business, commerce and law attract payments of $2,120, compared with students of science and mathematics ($10,432) and engineering ($18,240). Currently, for each business place offered by a university above their 2017 enrolment level, the university is effectively penalised by $2,120 (revenue from the Commonwealth foregone); for each science student, the penalty is $10,432. Universities may therefore recruit almost five new business students for the same cost as one science student.

[3] STEM Partnerships Forum, op. cit., p. 15.

questions raised in the issues paper but comments only on those areas in which ACU has relevant experience and expertise.

CHAPTER 1: STEM IN EDUCATION AND WORK

Question 1.6: Is the ATAR sending the wrong signals to schools and students about choosing science and mathematics subjects appropriate for anticipated university courses? What is the evidence for this and how can this be addressed?

The accuracy of the Australian Tertiary Admission Rank (ATAR) in forecasting success at university is often questioned by education experts.[4]

It is important to remember that the ATAR is a singular representation of a point in time, and ATAR performance is affected by a myriad of factors in a student's life. Moreover, as a ranking tool, the ATAR grossly exaggerates the small differences in scores of students who are clustered around the middle of the bell curve.

In almost all cases, the minimum ATAR for a university course reflects only the number of places available in the course and applicant demand for that course. It does not describe how 'difficult' a course may be or what type of student is likely to thrive in that course. For these reasons, ACU considers factors beyond the ATAR when assessing applicant suitability and likelihood of success.

ACU's student recruitment experience supports the research cited in the issues paper, which shows a reluctance among senior students to tackle high-level mathematics and sciences, in favour of subjects in which they might achieve higher marks.[5] At ACU Open Days and other promotional events, particularly in the years when ACU was introducing new STEM-related courses, staff spoke with a number of students who expressed a real passion for a STEM career but who had dropped mathematics in senior school in order to optimise their ATAR. These students made the decision to avoid mathematics, knowing that mathematics was not a pre-requisite for entry to STEM courses at several universities.

Question 1.7: Do you agree with the premise that the lack of prerequisites for entry into university courses sends the wrong signals to schools and students? What is the evidence for this?

At ACU, the Bachelor of Science degree has prerequisites in both mathematics and science for applicants. However, as mentioned above, ACU frequently encounters secondary students who would like to study STEM courses at university but who have chosen to undertake no STEM subjects in Years 11 and 12 to maximise their ATAR. These students are aware that some universities will allow them entry with no prerequisites in STEM subjects.

Prerequisites for course entry have many effects. At one level, they a guarantee a minimum level of knowledge and experience to support future success in study. However, at another level, prerequisites create a barrier to entry. For high school students, meeting a prerequisite for university entry requires advance planning, which often needs to begin in Year 10. Many students struggle with the maturity and self-awareness necessary for career-planning. If a student matures late or changes their desired career path in senior high school, they may not have sufficient time to meet the required semesters of study in a STEM course before applying to university.

The "opening up" of university to a greater range of applicants must always be accompanied by a deep commitment to student success. For example, a recent internal analysis of courses across the ACU Faculty of Health Sciences

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[4] The correlation between entry scores and university performance has been found to be "very strong for students with entry scores above 80, very weak to non-existent for scores between 80 and 40, and stronger but very variable for scores below 40". See Gavin Moodie, 'FactCheck: does your entrance score strongly correlate with your success at university?' *The Conversation* (23 July 2013). See also Willis, S., (2011). *Monash University: A High Quality/High Access University that Successfully Marries Excellence and Equity;* James, R., Bexley, E., and Shearer, M., (2009). *Improving Selection for Tertiary Education Places in Victoria*.

[5] Ibid, pp. 25-6.

demonstrated that courses with more complex prerequisite requirements had better student retention rates than courses with few or no prerequisites. This suggests that prerequisites do have a role to play in STEM courses. Enabling (bridging) courses focused on STEM subjects also support more applications into these fields of study, allowing school-leavers and those already in the workforce to change direction or advance their study in STEM fields.

ACU notes Provisional Recommendation 1 in the issues paper: that universities should reinstate prerequisites for entry to STEM courses. ACU acknowledges the intention of the recommendation but emphasises the importance of each university maintaining autonomy in relation to its admissions policies. Each university possesses deep knowledge of its surrounding community and of the most appropriate processes for selecting its students.

While it is open to the Forum to recommend a best practice approach, ACU would oppose the imposition of a uniform policy across all universities. Instead, ACU would suggest that universities admitting students to STEM courses without prerequisites should be reviewing each student's STEM knowledge/achievement at the beginning of their first year of study, in order to identify and deliver tailored support for that student. This would go some way towards ameliorating any negative effects of admitting students without prerequisites for STEM.

Recommendation 2: That universities balance access to STEM courses with the provision of support for student learning, to ensure that students not subject to STEM prerequisites have every opportunity for success.

CHAPTER 2: THE ROLE OF INDUSTRY

Question 2.3 b): How can universities and vocational training institutions help industry to develop partnerships and support STEM education in schools?

In order to provide engaging STEM education to school children, Australian schools need a workforce of teachers with skills and content knowledge to match. Universities can make an enormous contribution to this workforce development by offering high-quality undergraduate and postgraduate courses for aspiring and current teachers. Awards at different levels can enhance existing skills or add STEM fields of knowledge to teacher specialisations.

Universities are therefore in an excellent (structural) position to foster strong, effective partnerships between STEM industries and schools. In fact, industry-school partnerships should *include* universities that provide teacher education so as to create the best possible conditions for sharing expertise, knowledge and innovation along the STEM education pipeline. Collaboration is the key, and ACU supports a more formal approach to embedding collaboration among teachers and practitioners of STEM, extending the work already underway through programs such as STEM Professionals in Schools and the STEM X Academy (as outlined in the issues paper, p. 39).

Recommendation 3: That a formal program be established to offer teachers STEM secondments, for the purpose of upgrading their subject knowledge and professional capacities over a period of 6-12 months. Host organisations could include, for example, CSIRO, Google and Tesla.

CHAPTER 3: TEACHER PROFESSIONAL DEVELOPMENT

ACU strongly supports the goal, expressed in the issues paper, that, '[w]e must provide our young students with deep knowledge, continuous learning skills, cooperation skills and facility with evolving digital technologies'.[6] To this end, ACU supports the Forum's recommendation for an increased emphasis on discipline-specific professional development for teachers (Provisional Recommendation 3).

International best practices in STEM education in comparable OECD countries (Finland, Germany, Singapore, the U.K., the U.S. and New Zealand) show that in-depth teacher professional development, linked to resources that are

[6] STEM Partnerships Forum, op. cit., p. 17.

relevant and authentic, can build teacher capacity and confidence in STEM.[7] Building teacher capacity and confidence is crucial because teacher self-efficacy (how teachers view their capacity to positively affect student learning) is strongly associated with teaching success. In science and mathematics, in particular, teacher self-efficacy is highly dependent on content knowledge.[8]

The Australian study (cited above) on international best practice emphasised the importance of allowing teachers to develop depth of knowledge and skills within a particular STEM discipline.[9] ACU supports the recommendation contained in the 2014 Teacher Education Ministerial Advisory Group report that all new graduate primary school teachers should have at least one subject specialisation, with priority accorded to science, mathematics and foreign languages.[10] ACU further believes that *all* primary teachers, not just new graduates, should meet this requirement for subject specialisation.

ACU believes (and has recommended to the *Review to Achieve Educational Excellence in Australian Schools*) that teachers should be encouraged to hone their core function – teaching – through regular professional development. However, the time available for professional development is often very limited, particularly due to the administrative burden placed on teachers. This burden could be reduced by transferring non-core tasks to support staff, namely para-professional staff and final-year teaching students working as paid interns.

It is beneficial for STEM teachers to have the opportunity to rotate through professional development and classroom time in order to collaborate with practitioners in the field, research literature on current developments and best practices, and reflect on their own practice and experience.

ACU also supports Provisional Recommendation 4, with its emphasis on the role of industry in connecting teachers with the latest developments in STEM. Greater collaboration between schools, industry and universities is useful, as content and approaches to STEM are constantly and rapidly evolving. In Australia, it is projected that a 1 per cent increase in people choosing a STEM-related career would result in economic benefits of close to $60 billion over a 20-year period.[11] Australia therefore has a vested interest in connecting teachers with the latest developments in their field to build discipline knowledge that is the foundation for future interdisciplinary approaches to education and work.

Recommendation 4: That the subject specialisation requirement currently being implemented for new primary teachers be applied to the entire primary teacher workforce, with an emphasis on STEM specialisation.

Recommendation 5: That teachers be allocated more time for subject-specific professional development, by transferring non-core tasks to support staff (namely, para-professional staff and final-year teaching students working as paid interns).

[7] Chapman, Sarah & Rebecca Vivian. (2017). *Engaging the future of STEM: A study of international best practice for promoting the participation of young people, particularly girls, in science, technology, engineering and maths (STEM).* Funded by the Australian Government (Office for Women, Department of the Prime Minister and Cabinet), in partnership with the Chief Executive Women (CEW) Ltd, p. 37.
[8] See Stohlmann, Micah, et al. (2012). "Considerations for Teaching Integrated STEM Education," *Journal of Pre-College Engineering Education Research* (J-PEER): Vol. 2: Iss. 1, Article 4.
[9] Sarah Chapman & Rebecca Vivian, (2017), see note 7 above, p. 52.
[10] Teacher Education Ministerial Advisory Group. (2014). *Action Now: Classroom ready teachers*. Canberra: Department of Education and Training.
[11] PricewaterhouseCoopers (PwC). (2015). *A smart move: Future-proofing Australia's workforce by growing skills in science, technology, engineering and maths (STEM)*. April 2015.

ATTACHMENT A: AUSTRALIAN CATHOLIC UNIVERSITY PROFILE

Australian Catholic University (ACU) is a publicly-funded Catholic university, open to people of all faiths and of none and with teaching, learning and research inspired by 2,000 years of Catholic intellectual tradition.

ACU operates as a multi-jurisdictional university with seven campuses across four states and one territory. Campuses are located in North Sydney, Strathfield, Canberra, Melbourne, Ballarat, Brisbane and Adelaide. ACU also shares a campus in Rome, Italy with the Catholic University of America.

ACU is the largest Catholic university in the English-speaking world. Today, ACU has more than 33,000 students and 2,300 staff.[12]

ACU graduates demonstrate high standards of professional excellence and are also socially responsible, highly employable and committed to active and responsive learning. ACU graduates are highly sought-after by employers, with a 94 per cent employment rate.[13]

ACU has built its reputation in the areas of Health and Education, educating the largest number of undergraduate nursing and teaching students in Australia[14] and serving a significant workforce need in these areas. Under the demand driven system, ACU sought to focus and build on these strengths.

Since 2014, ACU has had four faculties: Health Services; Education and Arts; Law and Business; and Theology and Philosophy. The consolidation of the previous six faculties has created a more efficient and competitive structure focused on the needs of industry and employment partners.

As part of its commitment to educational excellence, ACU is committed to targeted and quality research. ACU's strategic plan focuses on research areas that align with ACU's mission and reflect most of its learning and teaching: Education; Health and Wellbeing; Theology and Philosophy; and Social Justice and the Common Good. To underpin its plan for research intensification, ACU has appointed high profile leaders to assume the directorships, and work with high calibre members, in seven research institutes.[15]

In recent years, the public standing of ACU's research has improved dramatically. The 2015 Excellence in Research for Australia (ERA) assessment awarded ACU particularly high ratings in the fields of research identified as strategic priorities and in which investment has been especially concentrated. These include selected areas of Health, as well as Education, Psychology, Theology, and Philosophy, in which ACU's research was rated as "above" or "well above" world standard.

[12] Student numbers refer to headcount figures while staff numbers refer to full-time equivalent (FTE).

[13] *Graduate Outcomes Survey (GOS) 2016.*

[14] Department of Education and Training, *2014 Higher Education Data Collection – Students, Special Courses* (31 July 2015) <https://docs.education.gov.au/node/38139>.

[15] Australian Catholic University, *ACU Research* <http://www.acu.edu.au/research/research_institutes_and_programs >.