

The role of education in promoting Australia's research capacity

Introduction

- 2.1 There is little doubt that Australia's education system plays a significant role in underpinning Australia's research capacity and hence its national competitiveness in science, research and innovation.
- 2.2 La Trobe University submitted that:
- ... the assessment of innovation should include the role of education ... for training minds for flexible responses and lateral thinking.¹
- 2.3 The South Australia Government argued that it is essential that Australia has:
- ... an education system ensuring high quality teaching and learning in maths and science and the social sciences at all levels of the education system.²
- 2.4 The Committee agrees that the 'development of an interest in a research career is a process that starts in childhood'.³ This chapter examines the role of the entire education system – at the primary and

1 La Trobe, *submission 48*, p. 2.

2 South Australia Government, *submission 98*, p. 2.

3 Universities Australia, *submission 82*, p. 11.

secondary school level, undergraduate tertiary level, and Honours year – in promoting interest in research.

Developing an interest in research: primary and secondary education

- 2.5 The Committee received overwhelming evidence testifying to the importance of the primary and secondary years as a “critical window” for developing a love of learning, an interest in research and an awareness of the myriad career options available in research.⁴
- 2.6 The Walter and Eliza Hall Institute of Medical Research (WEHIMR) stated that ‘the engine house of Australia’s future innovation is its primary and secondary schools’.⁵
- 2.7 Australia’s supply of potential researchers depends on the ability of primary and secondary education systems to encourage inquisitive and creative minds to consider the possibilities of research. This outcome can be achieved by enhancing the attractiveness of foundational curriculum subjects, the quality of teachers in Australian schools, equity in access and infrastructure, and exposure to researchers.

Curriculum

- 2.8 A key element in feeding the research pipeline is the availability and attractiveness of basic curricula to primary and high school students that enable them to pursue emerging interests and build further skills. A secondary element is the production of qualified teachers to underpin a strong curriculum and nurture research interest.
- 2.9 Australian Education Union noted that:
- In our high school years and, prior to that, in our primary years where we prepare our students for high school, we should not lose sight of the importance of a broad and balanced education and a broad and balanced individual.⁶

4 AAS, *transcript of evidence 18 June 2008*, p. 2; Mrs Sandra Muecke, *transcript of evidence 6 August 2008*, p. 62; CSIRO, *transcript of evidence 3 September 2008*, p. 11; CRCA, *transcript of evidence 3 September 2008*, p. 13; WEHIMR, *submission 34*, p. 2; AEU, *submission 99*, p. 1.

5 WEHIMR, *submission 34*, p. 2.

6 AEU, *transcript of evidence 9 September 2008*, p. 18.

2.10 Australian Education Union further submitted that:

We need to get it right with the science and the maths curriculum and other areas of learning. The inquisitive mind is not only restricted to science teaching and maths teaching. History can develop an inquiring mind and instil a love of research; any subject can. If we properly resource it and provide the resources in our schools to achieve it, then we will go a long way as a nation.⁷

2.11 The Committee is concerned that students currently shun subjects in the sciences, maths and humanities in favour of other subjects that appear easier or more attractive in terms of maximising tertiary entrance scores. This is likely to lead to fewer students acquiring the basic skills and knowledge that are required later in life to embark upon a research pathway.

2.12 Australian Education Union attributed changing student choices to changes in school curricula:

Some 10- or 15-odd years ago or 20 years ago, when maths and science were simply not considered sexy, if I can use a populist term ... we had a dramatic decline in the number of students participating ... in the same numbers in the sciences, the maths and the humanities, including history, for example ... That is largely because we saw an expansion – this is not uniform across the country, of course, but it is applicable in some ways – of a range of other subject areas that were introduced in the senior curriculum, including computing studies and legal studies. A whole series of studies were introduced in the curriculum, such as business studies. There was the whole expansion of vocational education and training subjects in the higher secondary area ...⁸

2.13 The broader curriculum may have contributed to the decreasing number of high school students opting to study science subjects. The Australian Academy of Science links the declining number of science students to the current shortage of scientists and engineers.⁹

7 AEU, *transcript of evidence 9 September 2008*, p. 21.

8 AEU, *transcript of evidence 9 September 2008*, p. 17.

9 AAS, *Research and Innovation in Australia: a policy statement*, September 2007, p. 7; <www.science.org.au/reports/aas-policy-2007.pdf>, viewed 28 October 2008.

- 2.14 Flinders University noted that mathematics and languages are two other areas wherein Australia's future capacity is compromised.¹⁰ The Australian Academy of the Humanities also alleged that Australia's language capacity requires attention given the low level of foreign language acquisition skills at the postgraduate level.¹¹
- 2.15 University of Queensland is addressing the lack of interest in these fields by offering bonus points to tertiary entrance ranks to students who successfully undertake a specific mathematics level or a Language Other Than English (LOTE) in Year 12.¹²
- 2.16 Australian National University noted that:
- Clearly, stimulating primary school and secondary school students to go on not only in science, technology, engineering and mathematics but also in languages other than English – those sorts of areas where we are starting to see shortages in our tertiary sector – would be very valuable, but it is something that would take considerable investment.¹³
- 2.17 The Committee commends the current national curriculum process which has drawn attention to much-needed changes to Australia's school curriculum, and looks forward to the National Curriculum Board's curriculum plan.

Quality of teaching and infrastructure

- 2.18 The Committee acknowledges the importance of highly-qualified teachers as role models and sources of inspiration in demonstrating and promoting the relevance of research to students.
- 2.19 The Committee is of the opinion that the quality of teaching in primary and secondary schools is a significant area for improvement and investment. The Committee expresses concern at the shortage of properly-qualified science and maths teachers, and the fact that teachers are placed in classes with little or no training in the subject matter.¹⁴

10 Flinders, *submission 78*, p. 2.

11 AAH, *submission 61*, p. 12.

12 UQ, *supplementary submission 100.1*, p. 3.

13 ANU, *transcript of evidence 27 August 2008*, p. 15.

14 Group of Eight, *transcript of evidence 25 June 2008*, p. 6; AATSE, *submission 6*, p. 5; see Harris, Kerri-Lee et.al., *Who's Teaching Science? Meeting the demand for qualified science teachers in Australian secondary schools*, January 2005, <www.acds.edu.au/>, viewed 29 October 2008.

- 2.20 Barry McGaw, chairman of the National Curriculum Board, also flagged a potential hitch in the introduction of the revised curriculum, to be launched in 2011, if the current short-fall of history, maths and science teachers is not addressed.¹⁵
- 2.21 Australian Academy of Science submitted that:
- First year university teaching now has many remedial elements, to accommodate the deficiencies arising from inadequate schooling and the less rigorous entry standards adopted to fill quotas.¹⁶
- 2.22 Australian Academy of Science believes that:
- ... Australia will not be able to heighten its skills in mathematics and science until it ensures that prospective scientists are taught by teachers with degrees in the disciplines for which they are responsible ... Only when programs are expanded to encourage high school students to study science and mathematics through teachers with degrees in their teaching disciplines can other issues such as tertiary level research training be fully addressed.¹⁷
- 2.23 The Committee is of the opinion that better employment conditions are necessary to attract and retain high-quality teachers in all fields and believes that this is an area that deserves further attention. The Committee is aware of innovative practices, particularly overseas, such as competitive remuneration, performance or qualification bonuses, tax deductions for further education costs, high-standard in-service training, and constant evaluation.¹⁸
- 2.24 Australian Education Union also noted the importance of adequate and well-maintained infrastructure:
- High quality teaching and learning also requires high quality infrastructure, including buildings, science facilities and equipment.¹⁹
- 2.25 The Commonwealth Scientific and Industrial Research Organisation (CSIRO) described their experience with taking science programs into schools with under-supported infrastructure:

15 Farrah Tomazin, 'New curriculum's teacher challenge', *The Age*, 12 November 2008, p. 12.

16 AAS, *submission 45*, p. 3.

17 AAS, *submission 45*, p. 3.

18 AEU, *transcript of evidence 9 September 2008*, p. 25.

19 AEU, *submission 99*, p. 1.

... we have to face up to the fact that unless we take equipment there, the schools often do not have it. We are looking forward to the use of broadband and so on to help that, but it is a major problem.²⁰

- 2.26 Investment in infrastructure has been found to be applied unevenly across Australian schools; a recent study found a major per capita gap of over \$1 000 between public and private school capital funding.²¹
- 2.27 The Committee believes that every student should have access to adequate learning facilities, and recommends the improvement of infrastructure in all Australian primary and secondary schools.

Recommendation 1

The Committee recommends that the quality of teaching and infrastructure at Australian primary and secondary schools be improved, particularly in the fields of maths and sciences. The Committee further recommends that the Australian Government and COAG investigate innovative measures taken overseas to address this particular concern.

Equity

- 2.28 The Committee is mindful of the need for all students, regardless of geographical location, background or socio-economic status, to have equal access to adequate curriculum, infrastructure and high-quality teachers.
- 2.29 Australian Education Union argued that:

... we need to ensure that every kid has access to the same rigorous, rich and rewarding curriculum ... People who talk about a different curriculum for some kids as opposed to others basically are arguing that some kids should not have the keys that open the doors of opportunity in this world of ours.²²

20 CSIRO, *transcript of evidence 3 September 2008*, p. 7

21 Adam Rorris, *Rebuilding Public Schools*, June 2008, p. 14, <www.aeufederal.org.au/Publications/Rebpucschls.pdf>, viewed 17 November 2008.

22 AEU, *transcript of evidence 9 September 2008*, p. 21.

2.30 Curtin University of Technology told the Committee that:

I think sometimes, under the guise of excellence and standards, we have actually narrowed opportunities for our young people to pursue science and math ... we create an elitism in those areas. Schools do not want their [Tertiary Entrance Rank] scores to look bad, so they channel children [away from certain subjects] who might have capability but who may not do justice to the curve ... ²³

2.31 The Committee is committed to the principle of equality of access to education, and encourages the availability of learning opportunities in all disciplines.

Exposure to researchers

2.32 The Committee supports efforts to link school students with researchers and professionals as a means to demonstrate the relevance of studying mathematics, hard sciences, humanities and languages. Year 10 and 12 work experience is one such program which enables students to gain an insight into career possibilities.

2.33 Several submissions to the inquiry mentioned initiatives designed to support greater industry-school linkages. CSIRO runs a 'Scientists in Schools' program which contributes to the authenticity and appeal of studying science subjects²⁴ as well a national Student Research Scheme which provides secondary students with research experience with scientists.²⁵ The Australian Nuclear Science and Technology Organisation (ANSTO) conducts school group tours and provides resources to teachers on salient topics such as climate change and water.²⁶ Many Cooperative Research Centres (CRCs) have developed educational resources, science kits, and workshops for pre-school, primary and secondary levels.²⁷

2.34 The Committee welcomes these and similar State-funded programs, and encourages access by as many schools as possible, particularly in rural and regional Australia.

23 CUT, *transcript of evidence 12 August 2008*, p. 31.

24 See CSIRO, *submission 83*.

25 Dr Adam Cawley, *transcript of evidence 5 August 2008*, p. 40; see also <www.csiro.au/org/StudentResearchScheme.html>.

26 ANSTO, *transcript of evidence 5 August 2008*, p. 81.

27 See CRCA, *submission 41*.

Developing an interest in research: tertiary education

- 2.35 The pipeline that feeds future researcher generations continues to experience problems at the tertiary level: inadequate standards of prior education; declining interest in science and mathematics degrees; and decreasing quality of teaching. The value and role of the Australian Honours degree is also under discussion.

Undergraduate education

- 2.36 Some submitters criticised a perceived lowering of academic standards at universities in response to falling numbers of prospective students with appropriate prerequisites and interest in subjects perceived to be difficult. The Australian Academy of Technological Sciences and Engineering warned that:

There is a need in undergraduate courses to ensure that [they] are not overly vocational. Students must receive an adequate grounding in basic sciences if they are to successfully undertake postgraduate research studies. This is seen to be a particular problem in the applied environmental sciences.²⁸

- 2.37 Research Australia argued that vocational training has neglected research skills development, leaving students ill-equipped to contemplate a research career.²⁹
- 2.38 RMIT University recommended that the Australian government introduce undergraduate internships in research fields of current priority.³⁰
- 2.39 Furthermore, the quality of teaching is at risk due to unfavourable employment trends. The University of Queensland Branch of the National Tertiary Education Union (NTEU-UQ) submitted that:

The quality of teaching in Australian universities has suffered from funding cuts and restructuring, resulting in:

- reduced numbers of tenured academics,
- reduced range of expertise within the faculty,
- greatly increased teaching and administrative loads on remaining academics,

28 AATSE, *submission 6*, p. 6.

29 Research Australia, *submission 70*, p. 10.

30 RMIT University, *submission 63*, p. 3.

- engagement of casual staff and graduate students to undertake teaching, including course coordination.³¹
- 2.40 Australian Universities Quality Agency (AUQA) argued that a high proportion of research-active academics at universities sustains the kind of 'intellectual climate' that fosters an appreciation for research.³² The University of Western Sydney agreed that 'students catch the research bug through exposure to enthusiastic researchers as lecturers'.³³
- 2.41 However, only seven Australian universities employ academic staff with a 70 per cent or greater rate of PhD qualifications, and 14 universities struggle to employ more than 55 per cent of their staff with PhD qualifications.³⁴ The submission from the Australian Deans of Built Environment and Design (ADBED) admitted that, although many potential employees possess excellent practical experience, finding academic staff with PhD qualifications and research backgrounds is problematic in that discipline.³⁵

Honours

- 2.42 The Committee received evidence both supporting and contesting the role of the undergraduate Honours year in the pathway to higher degrees by research. Honours is generally considered an important step for research training to be encouraged among undergraduate students. On the other hand, there are calls to modernise the current degree structure. The Committee also recognises that post-Honours entry to higher degrees by research is no longer the primary entry point to research training and as such, the degree structure should accommodate various entry points.
- 2.43 Drs Zeegers and Barron claimed that there was a:
- ... 12% increase of graduates going from Honours degrees to higher research degrees between 1992 and 2001, suggesting that the relevance of Honours in relation to research degrees is a salient consideration for the future of research training to

31 NTEU-UQ, *submission 59*, p. 7.

32 AUQA, *submission 14*, p. 6.

33 UWS, *submission 10*, p. 4.

34 ANU, *submission 23*, p. 1.

35 ADBED, *submission 39*, pp. 4-5.

support Australia's anticipated future requirements for tertiary-qualified professionals.³⁶

2.44 They further suggested that:

... the assumption of a vibrant Honours program increas[es] the likelihood of cohorts of well trained researchers for timely, if not early, completions, and further provid[es] a pool of possible future academics to staff university programs and high level industry placements.³⁷

2.45 Research Australia suggested providing Honours scholarships to attract students who might otherwise choose competitive graduate salaries over the expense of another year of study.³⁸

2.46 However, the 'honours pathway to a PhD is an Australian story'³⁹ that has been labelled 'internationally ... an anachronistic gold standard'.⁴⁰ Not only does it compare unfavourably with international norms, assessing Honours equivalence for the growing number of non-Honours applicants is problematic.⁴¹ Griffith University advised that half their higher degree by research students possessed alternative qualifications, such as Masters by coursework.⁴²

2.47 The Australian Council of Deans of Education submitted that Honours is not the preferred pathway in the education field:

Research in education is typically applied research that requires the research student to be familiar with a broad range of professional issues, and to grasp the complex interface between theory and contexts of policy formation and professional practice. The undergraduate honours pathway, by itself, is unlikely to provide this grounded professional expertise.⁴³

36 Dr Margaret Zeegers and Dr Deirdre Barron, *submission 3*, p. 2.

37 Dr Margaret Zeegers and Dr Deirdre Barron, *submission 3*, p. 2.

38 Research Australia, *submission 70*, p. 3.

39 CUT, *transcript of evidence 12 August 2008*, p. 45.

40 Griffith, *transcript of evidence 18 August 2008*, p. 40.

41 CUT, *transcript of evidence 12 August 2008*, p. 45. Assessing equivalence is also inconsistent, as the Commonwealth Scholarships Guidelines give the responsibility of determining First Class Honours equivalence to each individual higher education provider: *Higher Education Support (Commonwealth Scholarships Guidelines) Act 2003*, p. 10.

42 Griffith, *transcript of evidence 18 August 2008*, p. 40.

43 ACDE, *submission 88*, p. 2.

- 2.48 In 1999, European nations instituted the Bologna process to standardise academic degrees throughout Europe, and subsequently adopted the Bologna degree structure, which is comprised of a broad three- or four-year undergraduate degree, a more specialised two-year Masters degree, and a three-year research doctoral degree.
- 2.49 Some submissions indicated a preference for the Bologna model over Australia's shorter undergraduate-Honours-PhD framework,⁴⁴ and in fact the University of Melbourne has already instituted a Bologna-like degree structure.⁴⁵
- 2.50 The Committee recognises that Australian graduates may not compete effectively against Europeans or Americans whose countries:
... do not assume that merely by having a prior degree with some research training (e.g., Honours in Australia) that students are adequately prepared for PhD level research.⁴⁶
- 2.51 The Committee supports the continuation of an assessment by an Australian Government steering group and the tertiary sector of the suitability of Australia's research training model for current globally-competitive conditions.⁴⁷

44 Professor Peter Drummond, *submission 58*, p. 1; Griffith, *transcript of evidence 18 August 2008*, p. 40; NTEU-CQU, *transcript of evidence 19 August 2008*, p. 2.

45 <www.futurestudents.unimelb.edu.au/about/melbournemodel.html>, viewed 12 November 2008.

46 Professor Allan Borowski, *submission 103*, p. 1.

47 <www.aei.gov.au/AEI/GovernmentActivities/BolognaProcess/NatSeminar.htm>, viewed 26 November 2008.

