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Background

- I have been a secondary teacher, education consultant, university academic and my final position before retiring was Executive Officer at the Australian Mathematical Sciences Institute (AMSI). I still have an honorary position at AMSI but this is a personal submission.
- I have had extensive experience in policy across the science disciplines, especially through a long association Federation of Australian Scientific and Technological Societies (now Science Technology Australia) as a Board member and Vice-President. While this submission considers mainly the mathematical sciences, many other disciplines that are vital to Australia's future are also under threat while monetary considerations constrain the offerings at universities. For example, I would cite geophysics and entomology, critical to the mining industry and biosecurity respectively.
- I summarised what I perceived at the 'crumbling cake' of mathematical sciences in Australia in 2020 ([AustMS Gazette 2020](#)). [AMSI Occ Paper2](#), which I co-authored, documents the decline in mathematics teachers supply as student numbers have escalated.

Historical perspective

What is described here could also apply to other disciplines but will just consider mathematics. There was a review of the mathematical sciences, under the auspices of the Australian Academy of Science, published just prior to the 1996 Federal election. The review was generally very positive but noted the need for new positions in the universities, especially in newer areas. This was expected to follow from expected retirements in the following years. This did not happen.

The Howard government higher education policies focussed universities on financial support from international students. Few international students come to Australia to study mathematics. At best university mathematical sciences departments gained some service teaching. But even that was compromised with other disciplines teaching what should have been taught in mathematics departments. This was highlighted in a by the international reviewers in a [2006 Review](#):

Australia's distinguished tradition and capability in mathematics and statistics is on a truly perilous path. The decline has already taken its toll: the university presence has been decimated, in part by unanticipated consequences of funding formulas and by neglect of the basic principle that mathematics be taught by mathematicians, and the supply of students and graduates is falling short of national needs (p.9).

This decline was documented in [FASTS Occasional paper 2](#). By 2000, Australia had lost many of its best mathematicians and statisticians to overseas. As documented in the paper, Australia lost out to the likes of Harvard, Oxford and Cambridge. There has been a slow rebuild of mathematical sciences in the universities but it not uniform. Many regional universities never regained what they had lost. Positions were again lost due to COVID and the lack of government support for public universities during this time.

Key areas of the review

Some brief comments only, following on from the above

1. Meeting Australia's knowledge and skills needs, now and in the future

- The mathematical sciences underpin Australia's security, research in many disciplines, business and industry. As outlined above, the state of mathematical sciences in the universities does not meet Australia's knowledge and skills needs. This is particularly so of

many of the smaller regional universities. An undergraduate degree in mathematical sciences is not offered in the Northern Territory and only in Bendigo in Victoria. To compound problems in Victoria, VU does not have a major in mathematical sciences so the vast and growing Western suburbs are not fostering mathematical talent. The lack of access to mathematical degrees means that the supply of mathematics teachers is affected. The problems relating to the supply of mathematics teachers was first documented in the late 1980s. It is now critical, and universities must play a part in addressing this.

- Teacher shortages may in part explain the on-going decline in Year 12 advanced subjects (see [Year 12 mathematics enrolments](#)) and Australia's declining position in international assessments (TIMSS and PISA). This decline has a flow-on effect to other disciplines such as engineering, economics, computer science and data/security.
- Mathematics is fundamental to so many areas that it should be a part of every university offering. There needs to be an expectation that this is expected and funded accordingly.
- Some years ago, the UK had a special fund for supporting small subjects and other areas of national need such as mathematics. This may be something that Australia could consider.

2. Access and opportunity

While there is an inadequate mathematics teacher supply, equity groups will continue to be disadvantaged in access to many areas. This is highlighted in recent study from ACER, [STEM pipeline](#). To quote from the report:

- *The findings of this research show that within the STEM pipeline, the transition from school into university, and from university into the STEM workforce are two critical areas containing leaks for equity groups, especially women and people from low SES backgrounds.*
- *The findings also support the idea that persisting with a STEM pathway into university may depend on developing a STEM profile in early adolescence. This STEM profile is characterised by higher self-confidence with mathematics and valuing mathematics as a career and life aspiration.*

3. Investment and affordability

- Can Australia afford not to invest in the mathematical sciences?

4. Governance, accountability and community

5. The connection between the vocational education and training and higher education systems

Mathematics in the VET sector is complemented by what else is happening in education and training. The overall shortfall in teachers will affect VET. Are the teachers there who can distil out the mathematics used and required in the many trades and make it relevant and meaningful to apprentices?

6. Quality and sustainability

As a core capability, mathematical sciences must be robust at the national level. There is international demand for mathematical skills and, while international students especially at the post-graduate level are valued and must be supported, this is not the answer to Australia's mathematical skills shortage. This is particularly true of security concerns.

