

Response to Review of Australian Higher Education Discussion Paper

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Preliminary comments:

The mathematical sciences community submitted preliminary comments to the Review of Higher Education (attached). We note that the Review is being conducted on a 'strong evidence base'.

We would cite the following evidence in regard to the failure of the current higher education system to provide the mathematical and statistical capability a modern technological society needs:

1. *Mathematical Sciences: Adding to Australia*, the 1995 review of mathematical sciences¹
2. *Mathematical Sciences in Australia: Looking for a future*, FASTS Occasional paper (2000)²
3. *Statistics in Australia*, a review of statistics in Australia (2005)³
4. *National Strategic Review of Mathematical Sciences Research in Australia* (2006)⁴
5. A survey of mathematical sciences department post the Review⁵

Collectively these reports show the slow erosion of the mathematical sciences in Australia's higher education system. In turn this is having a profound impact on the supply of teachers for our schools. There are numerous reports concerning teacher supply but the study by the Deans of Science is one of particular depth⁶. As further evidence the text of two email messages from a teacher in an urban Melbourne school is appended at the end of this response.

Collectively there is irrefutable evidence that the mathematical sciences in the higher education system are in serious trouble. This is not addressed in the Discussion Paper of June 2008.

In the Paper, the word **mathematics** occurs four times:

1. in reference to skills shortages in the higher education sector (p.22),
2. re shortages of graduates with mathematical skills in an extract from a UK document (p. 25),

¹ <http://www.review.ms.unimelb.edu.au/95Review.pdf>

² http://www.fast.org/images/occasional-papers/Lookingfor_future.pdf

³ <http://www.statsoc.org.au/Review0405/ReviewofStatsFinalReport.pdf>

⁴ <http://www.review.ms.unimelb.edu.au/>

⁵ http://www.amsi.org.au/pdfs/Questionnaire_summary.pdf

⁶ <http://www.acds.edu.au/>

3. in regard to the failure to increase demand for mathematics units by reducing student contributions at Deakin University (p. 32) and,
4. the low demand for mathematics from fee-paying students.

In summary issues in the mathematical sciences are given scant attention. Thus how to address Australia's needs in specific areas are not addressed. This is not specific to statistics and mathematics and would include geophysics, entomology, specific languages, quantitatively competent social scientists and other areas.

We do not believe these are trivial matters. Universities have been driven by the need to attract students to survive and have compromised accordingly. Small, expensive courses or those with low student demand have been sacrificed. The introduction of the Excellence in Research for Australia is likely to further drive support for existing strengths rather than areas which may be critical to Australia's future or that need strengthening.

Response to some specific questions

Q1. The statement of functions and characteristics is adequate but could be enhanced by reference to international best practice in regards to course length and curriculum.

Q 2-7. We believe that mathematics and statistics are crucial skills in wide demand by various research institutions, industry and business and that the demand is not being met. A major impediment to support for the mathematical sciences in the tertiary sector was a funding model that did not support good teaching and encouraged other disciplines to teach mathematics and statistics within their faculties. When the funding model improved, very little of the new money found its way to mathematical sciences departments which have continued to contract (footnote 5).

The mathematical sciences community does not believe that there will be a response from the tertiary sector as a whole to the mathematical sciences skills shortfall without government intervention. This could be punitive or by encouragement e.g. access to extra funds as a reward for producing graduates in designated areas.

Q 8-11. The current shortage of teachers of mathematics is having a profound effect on the ability of Indigenous and low SES groups to participate and succeed in higher education. While there is an urgent need to retrain existing teachers and other short-term measures, in the long term the flow of mathematical sciences graduates must improve. Further mathematics and statistics need to be re-introduced into degrees where it is the norm in other parts of the world e.g. all science degrees. This would vastly improve the potential pool of teachers who at least had some mathematics in their degrees.

Q 12-14. We estimate that, in the mathematical sciences, about 40% less staff than about 10 years ago are teaching about the same number of students, mainly first year service teaching. Subject choice, class sizes, assessment practices and student support are all compromised and do not encourage students to do more than mandated subjects.

Q 15-18. We would welcome improved movement between vocational education and higher education. If TAFE colleges were behaving more like the American Community Colleges, students who are currently disadvantaged in schools could access the mathematics they need to succeed in their chosen courses before embarking on tertiary studies. Further, if rural students were able to access first and second year level

university subjects in key discipline areas at a TAFE before moving to a mainstream university setting it could be an attractive and cheaper option. The current mathematics teacher shortage, which impinges on TAFE colleges as well as schools, mitigates the likelihood of this happening.

Q 19-21. Mathematical sciences span research and innovation. The role of statistics and mathematical modelling across disciplines is crucial. By definition a university should be engaged in research. However, we would question whether any institution should be called a university if it does not have an identifiable mathematical sciences group and is unable to offer a major in mathematical sciences. The number of institutions in this category is growing but many still profess to be research active in highly quantitative fields e.g. science and engineering.

Q 22-27. No comment.

Q 28-30. To quote the international reviewers for the 2006 Review of mathematical sciences:

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.

"The mathematical sciences skill base in any country is too important for its future prosperity to let short-term market mechanisms act alone. We sincerely hope that leaders in Australian Government, academia and industry will collaborate with the mathematics and statistics community to develop an appropriate vision, and spark an Australian renaissance in our field.

Yes, there have been unintended consequences in the current arrangements. But as has been documented (footnote 5), there is no value in additional funding to solve a particular issue if there is then no accountability that the money be spent in fixing the problem. We believe funding must be linked to measurable outcomes that are in the national interest.

Q 31-35. Governance and regulation needs streamlining. We would particularly highlight the need to tighten degree requirements e.g. the double degrees now offered by many universities e.g. B.Sc/B.Teach where the B.Sc is of only two years duration. The content of many teacher education courses is a major concern. We believe there are strong arguments for the federal government to take responsibility for accreditation of degrees to ensure that they of international standard in curriculum and duration.

Concluding comment

It is difficult to respond to the Discussion Paper as it does not have a focus on individual disciplines. However if core disciplines that underpin research, innovation, business and industry are not adequately supported across the tertiary sector, then national skills shortages will not be addressed. Further, many young peoples' life chances will be adversely affected. This is particularly so if many universities fail to offer majors in mathematics and statistics. Many of these universities are rural and most have very large number of education students.

The mathematical sciences community would welcome the opportunity to meet with the Review team and discuss our concerns further.

Teacher's email – 27 November 2007

I can tell you that the problems we are facing in my school are almost insurmountable. I have been dedicating enormous amounts of time trying to support teachers that are not 'maths trained' as they struggle through the curriculum. We are fielding complaints from parents almost on a daily basis. Parents are recognising that their child is not being taught 'mathematics'; at least they have not been given access to a 'qualified mathematics' teacher. This is becoming more and more apparent through the work that the students are doing in class.

Most recently I received a written request from a parent that their child be given a 'qualified mathematics' teacher next year since they haven't had one yet. The parent is concerned that their child is not making progress, through no fault of their own. Whilst I would love to promise access to such a teacher, I can not. In recent times, 11 out of 12 of our year seven 'mathematics' teachers were not qualified in mathematics. For most of them, they had not done any mathematics themselves since year 10/11. The statistics were not much better for our year 8 classes. We have been advertising for mathematics teachers for most of this semester and have been unable to fill the vacancies.

Today was a terrible day, I was advised by one of our Deputy Principals that the mathematics and science electives were being withdrawn, "we can not staff them". Even though we have students electing to study these subjects, we can no longer offer them.

Second email from same teacher – 13 May 2008

I am a mathematics teacher (18yrs exp) and more recently have become concerned about a couple of trends I suspect are happening in VCE Mathematics, specifically in Specialist Mathematics. Here are my concerns (observations)

Student Numbers - Specialist Mathematics

My school has 1500+ students, so too a neighbouring school, in fact combine four local Government schools and you will have more than 4500 student enrolments; yet collectively we would barely have enough students studying Specialist Mathematics to fill a single classroom!

Local private schools have no such problems. I believe there are a number of reasons for the decline in numbers. For example at my school (*name deleted*) we had on offer two elective studies in mathematics for our middle school students; an opportunity to enrich their understanding and appreciation of mathematics. The two classes were heavily subscribed... but sadly were cancelled because we didn't have enough mathematics teachers. Combine this with difficulties staffing our mathematics program... it is clear to see why there is a lack of success in our program. I understand we can not fix the Mathematics teacher shortage, but my concern is the massive impact it is having on our numbers studying Specialist Mathematics in Government schools.

Add to this complication is that when the numbers are low, the subject is dropped. Schools struggle to offer VCE subjects with fewer than 10 students; subsequently my school dropped Specialist Mathematics last year, despite four keen candidates. One candidate left the school, two others didn't study the subject (chose a different subject) and the third student did the subject by correspondence. This year, we have combined numbers with another local school... the class now runs with students studying

Specialist Mathematics for 3 consecutive hours one day after school... this isn't an ideal pedagogically speaking, and it doesn't meet the minimum number of hours required for the subject. I have asked the students "would you move schools to study Specialist". I was surprised when the answer came back 'NO'. This means a group of willing and capable students would have opted not to study Specialist Mathematics. I know some of the local private schools have relatively small numbers of students. This leaves the public school students (and their parents) in a dilemma...

- Pay large amounts of money to go private
- Attempt the subject via correspondence
- Drop out of the subject.

These options do not sound great!

My concern is that Specialist Mathematics is going to become a subject that is in the vast majority, restricted to private school education.

Preliminary input to the Review of Australian Higher Education

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The Review seeks to examine the current state of the Australian higher education system against international best practice and assess whether the education system is capable of:

- *contributing to the innovation and productivity gains required for long term economic development and growth; and*
- *ensuring that there is a broad-based tertiary education system producing professionals for both national and local labour market needs.*

The mathematical sciences community believes that the higher education system is currently failing to make sufficient contribution to both these major objectives and does not measure up to international best practice. In this brief initial submission, some key concerns are outlined.

A sound mathematical sciences base is fundamental to Australia's social and economic well-being because it underpins innovation and is critical to sciences, engineering and technology, finance and economics, security and many other areas. Modern mathematics and statistics are dynamic disciplines and, without a vibrant presence in the universities, Australia will fail to capitalise on new discoveries and applications.

Further, school mathematics provides young people with the skills to participate in a modern economy, make informed financial decisions and be able to assess statistical data including risks. Without an adequate supply of mathematically knowledgeable teachers, many young people do not acquire these skills. The supply of properly trained teachers of mathematics has implications for higher education that involve both mathematical sciences departments and education faculties. The report of the Deans of Science highlights the problems of mathematics teachers in schools who have inadequate training in mathematics¹.

The mathematical sciences in Australian universities are in serious trouble. The National Strategic Review of Mathematical Sciences Research in Australia completed at the end of 2006 documented just how serious the situation is in schools and universities². In Australia only 0.4% of students graduate with a major in mathematics or statistics compared with an OECD average of 1%. It also found that the major university departments lost more than 1/3 of their teaching and research staff between 1995 and 2006.

¹ http://www.acds.edu.au/Prep_Math_Teach_Aust.pdf

² <http://www.review.ms.unimelb.edu.au> - printed copies available on request

The National Review had two priority recommendations: (1) improved relative funding for the teaching of mathematical sciences in the universities and (2) support for national infrastructure. Improved relative funding for mathematics teaching was addressed with new money in the May 2007 budget. However, little of this money has found its way to mathematical sciences departments³. Further, proposed reductions at one university have led to international condemnation that is damaging to the reputation of Australian universities as a whole and mathematics in particular⁴.

Funding for national infrastructure for the mathematical sciences was recommended to be achieved through adequate funding for the Australian Mathematical Sciences Institute (AMSI). Funding of about 25% of the recommended level has been obtained for a three-year period. AMSI is modelled on Canadian institutes and is based on a small permanent staff and devolved activities. Further, AMSI integrates education, research and industry activities, a characteristic of the Canadian institutes⁵. AMSI has also set up an innovative network of access grid rooms to support efficient collaborative small group teaching at advanced levels across several institutions.

AMSI is an example of why innovative funding mechanisms are also needed to underpin some discipline areas. If collaboration and integration of different aspects of the various disciplines are to be fostered, account needs to be taken of the barriers that can exist when funding is specific to research, industry or education even within a single government department. The problems multiply when more than one department or agency is involved.

The Review of Higher Education addresses a number of themes. The first:

Developing a diverse, globally focused and competitive higher education sector with quality, responsive institutions following clear, distinctive missions to provide higher education opportunities to students throughout Australia.

needs careful implementation if Australian universities are to remain internationally competitive. In particular, it is in the national interest that universities ensure that their students acquire the mathematical knowledge and skills expected in other countries as part of their degrees. Unless this is accepted, then the other themes such as 'productivity and participation' are redundant.

The recent history of mathematical sciences in the universities indicates that it is not sufficient to allow individual institutions to determine their priorities in all areas. There are some fundamentals that should be accepted in the interest of the nation and students. To quote the international reviewers for the mathematical sciences:

"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."

"The mathematical sciences skill base in any country is too important for its future prosperity to let short-term market mechanisms act alone. We sincerely hope that leaders in Australian Government, academia and industry will collaborate with the

³ http://www.amsi.org.au/pdfs/Questionnaire_summary.pdf

⁴ <http://terrytao.wordpress.com/support-usq-maths/>

⁵ See <http://www.pims.math.ca/> or <http://www.fields.utoronto.ca/>

mathematics and statistics community to develop an appropriate vision, and spark an Australian renaissance in our field.”

A key to a renaissance is a higher education system that recognises the key role of mathematical sciences in Australia’s future, the need for the majority of students to include some mathematical sciences in their degrees and that this be taught by mathematicians and statisticians. This is standard in other nations and should be in Australia.

If the above is accepted, there is no reason why every Australian university cannot be expected to offer a three-year sequence in mathematics and statistics. Actions to achieve this, the responsible authority and key performance indicators can be found on pp. 76-77 on the National Review.

It is noted that the Panel intends to conduct the review of higher education on a robust evidence base. The National Review of Mathematical Sciences, and its analysis of the situation in Australia, provides robust evidence of the need for change.

We look forward to providing further input when the discussion paper is released in June.

21 April 2008