

## 4. Our Solutions

To complement the measures already taken, a coordinated national mathematics and statistics strategy is suggested that addresses:

- perceptions of the usefulness of mathematics and statistics;
- the serious shortfall of well-qualified teachers of mathematics in schools;
- the diminished state of mathematical sciences in the university sector; and
- mathematical and statistical infrastructure for business, industry and research.

### 4a. *Mathematical sciences and their importance to Australia*

Mathematical sciences are a hidden achiever. It is not obvious to the community at large that mathematics and statistics are critical to the vast majority of technologies they use every day. Four measures are therefore proposed that would put mathematics and statistics clearly into the public arena. These measures are intended to inspire students and their parents to appreciate both the importance of the mathematical sciences and the many exciting career options that depend upon developing good mathematical skills.

1. *Political leadership* – We are calling upon the Prime Minister and his parliamentary colleagues to reinforce the importance of mathematics to the future well-being of Australia and Australians.<sup>22</sup>
2. *Community awareness* – We are asking for a national campaign to promote mathematical sciences, their contribution to modern life and to Australia, and the critical role they play in many career options.<sup>23</sup>
3. *Student Encouragement* – We are looking to the Australian Government to promote its HECS reduction to beginning tertiary mathematics students.
4. *Teacher prizes* – We are recommending that the Prime Minister introduce annual Prime Minister's Prizes for mathematics teaching.<sup>24</sup>

### 4b. *Well-qualified teachers of mathematics in schools*

If more Australian students are to study advanced mathematics and if students at all levels are to have an appropriate number of hours of instruction<sup>25</sup>, it is clear that additional measures must be taken by our governments. The following seven initiatives address the current inequity in access to a quality mathematics education. Inequitable access is now endemic in Australia. The proposed measures are designed to improve the quality and quantity of mathematics teaching and learning and provide a mechanism for rewarding good mathematics teachers in primary and secondary schools.<sup>26</sup>

1. *Meaningful registration* – Australia needs a national registration system for teachers of mathematics, differentiated as appropriate for primary, junior secondary and senior secondary classes and based on content knowledge as well as pedagogical knowledge. Once registration is in place, it can inform workplace planning, including the allocation of teacher education places so there is a better match with teacher supply and school curriculum needs.<sup>27</sup>

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22 Briefing notes would be prepared by the mathematical sciences community

23 A draft action plan already exists and would be up-dated. See <http://www.maths.org.au/pdfs/careers.pdf>

24 When originally introduced it was suggested that the science prize would include mathematics teachers but this has never happened. There is a prize for primary and for secondary science teaching. Prizes have since been introduced for history and music.

25 Five hours has been suggested for primary and four for secondary to Year 10. See: [www.coag.gov.au/reports/docs/national\\_numeracy\\_review.pdf](http://www.coag.gov.au/reports/docs/national_numeracy_review.pdf)

26 The measures counter difficulties of across the board pay increases specific to mathematics teachers and possible problems with 'merit' based pay that may make teachers reluctant to move to 'difficult' schools.

27 For data on current imbalance see: [http://www.dest.gov.au/sectors/school\\_education/publications\\_resources/profiles/survey\\_final\\_year\\_teacher\\_education\\_students.htm](http://www.dest.gov.au/sectors/school_education/publications_resources/profiles/survey_final_year_teacher_education_students.htm)

2. *Primary specialists* – We also need to develop a distinct registration category of ‘primary mathematics specialist’ that attracts a substantial financial reward. ‘Primary mathematics specialist’ should be a distinct registration category linked to further studies in both mathematics and pedagogy.<sup>28</sup>
3. *New teachers* – The current economic situation provides opportunities to recruit suitable career-change professionals to mathematics teaching. We are seeking government support for career-change professionals interested in teaching mathematics. This would include income support, the development of courses appropriate to their needs, and ‘golden handshakes’ to acknowledge the additional work related skills they bring to schools.
4. *Tenure* – In conjunction with the States and Territories, we want government schools in Australia to ensure that all new teachers of mathematics have on-going positions after an initial probationary year.
5. *Refocus the HECS reduction* – We are asking the federal government to re-assess the HECS reduction for BSc graduates entering teaching to include graduates from other degrees (such as engineering, computer science etc) who meet the requirements of 1 above for senior secondary school teaching of mathematics.<sup>29</sup>
6. *Professional development* – We want all Australian governments to provide improved opportunities and support for teachers teaching ‘out-of-field’ to meet subject-based registration requirements as defined by 1.
7. *Promote equity* – We believe the Australian Government should provide substantial financial inducements to experienced and well-qualified mathematics teachers who are prepared to take positions in rural, remote and underachieving schools for a minimum of, for example, three years.

#### 4c. *Mathematical sciences in the university sector*

Mathematical sciences will never be strong in Australian schools, communities and businesses without an appropriate foundation in our universities. However political leadership is needed if Australia is to develop an outstanding higher education system for mathematics.

Our universities need to ensure that all Australian students have access to a major in the mathematical sciences should they wish to pursue one.<sup>30</sup> The integrity and standard of mathematics and statistics courses taught outside mathematical sciences departments must be monitored for content and standards. Our federal government needs to provide a more strategic use of the HECS reductions to encourage students to include mathematics and statistics in science degrees. We also need to be certain that our immigration policies do not cause Australia to lose in the international competition for mathematical talent.<sup>31</sup> To these, and related, ends we are proposing eight additional measures.

1. *Political leadership* – We believe the Minister of Education should write to all universities asking what improvements have been made to support mathematics and statistics since the funding for teaching these disciplines was increased in 2008.
2. *University leadership* – We want Australian Government compacts or similar agreements to ask universities specifically what steps they are taking to increase the number of graduates in mathematics and statistics.

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28 England is aiming for a specialist in every primary school. See: <http://publications.teachernet.gov.uk/default.aspx?PageFunction=productdetails&PageMode=publications&ProductId=DCSF-00433-2008>

29 Some provision for students at the University of Western Australia who do not have BSc label have already been made.

30 The designation of mathematics as part of the strategically important subjects program as in the UK could also be helpful. See: <http://www.hefce.ac.uk/aboutus/sis/>

31 The 2006 international reviewers noted that Australian universities were neglecting ‘...the basic principle that mathematics be taught by mathematicians’.

3. *Enabling infrastructure* – We are suggesting that Australian Government compacts or similar agreements also ask all universities in receipt of ARC and NHMRC funding to state what provision they have made for the mathematical and statistical expertise needed across disciplines.
4. *Refocus the HECS* – We are asking the Australian Government to re-assess the value of the HECS reduction for science students who are not completing a minimum of two semesters of mathematics or statistics.
5. *Direct scholarships* – As an alternative to HECS reductions, we want the Australian Government to consider providing up-front scholarships for students who undertake a mathematics major in their undergraduate degrees.
6. *Mathematics course accreditation* – We are calling for HECS reduction for mathematical units not taught by a mathematical sciences department to be monitored for mathematical and statistical content.
7. *Teacher training accreditation* – We are calling for the mathematics content of teacher education courses not taught by mathematics departments also to be accredited.
8. *Simpler immigration* – We are suggesting that the Australian Government simplify immigration procedures for mathematical scientists already in universities and intending to stay permanently.

#### **4d. Mathematical and statistical infrastructure**

The Australian Mathematical Sciences Institute (AMSI)<sup>32</sup> is core infrastructure supporting many activities that simply would not occur otherwise. An example is an industry workshop in July where the OECD is funding 15 participants from developing countries.<sup>33</sup> Another example is the internship program for postgraduate students.<sup>34</sup> Until the mathematical sciences are rebuilt, AMSI is the only way that Australia can provide collaborative, national mathematical infrastructure across the broader research community, business, industry and education. Through its members and the Australian Council of Heads of Mathematical Sciences for which it provides administrative support, AMSI is well placed to provide core support for teaching and research in mathematics as well as evidence for policy in the mathematical sciences.<sup>35</sup> We are calling for support for this mathematical and statistical infrastructure in four ways.

1. *Support AMSI* – We are asking the Australian Government to fund AMSI's core infrastructure and operations as recommended in the 2006 Review.<sup>36</sup>
2. *National expertise* – We are asking for policies to encourage AMSI's mission for the diffusion of mathematical and statistical expertise to business and industry, including SMEs, especially through its internship program.
3. *Use AMSI* – We are recommending that all governments use AMSI's national, collaborative infrastructure to provide evidence for government policy in the mathematical sciences.
4. *Statistical consulting* – We are calling for all universities to establish a mechanism to support 'intellectual infrastructure', specifically internal statistical consulting services.

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32 Winner of the 2008 Fast Thinking and Open Universities National Innovation Award for Science Innovation. See: [www.amsi.org.au](http://www.amsi.org.au)

33 <http://www.amsi.org.au/energy.php>

34 [http://www.amsi.org.au/Industry\\_internships.php](http://www.amsi.org.au/Industry_internships.php)

35 Gary Banks, Chair of the Productivity Commission, suggested 'going to the experts'. See: <http://www.pc.gov.au/speeches/cs20090204>

36 2006 National Strategic Review of Mathematical Sciences in Australia

## 5. A national strategy

The mathematical sciences are in need of repair. The time has passed when any single initiative will suffice and a coordinated national strategy is now required. The issues discussed here should be of concern in every State and Territory and in every electorate. The inequitable access to a quality mathematics education is a national disgrace. It will not be solved by isolated measures.

Many of the proposals put forward concern education. However, mathematical infrastructure for business, industry and research also concern the Science and Innovation portfolio. This is where policy for the promotion of science is currently situated and is where new policies for the promotion of mathematical sciences may possibly belong.

In recent years, the UK has turned its performance in mathematical sciences and education around in a remarkable way by combining aggressive teacher recruitment with substantial inducements, regulation of teacher education numbers to match demand from schools, an impressive careers program supported by the government and professional societies, and the designation of mathematics as part of the strategically important subjects program. Two tables from the London Mathematical Society concerning applicants for undergraduate mathematics programs and graduate teacher numbers are shown in Appendix 3.

The truth is Australian mathematics and mathematics education are in a dire state. But the British example shows that it is possible, by acting strategically, to turn things around. The mathematical sciences community asks for a bipartisan, national approach to ensure that similar results can be achieved in Australia. To quote the 2006 Review:

*“Australia is a big country, with a dispersed population. Ensuring a mathematical sciences base that supports teaching, research, and industry in remote and rural areas as well as the major population centres is a challenging task. **With sufficient will it can be done.**”*