

Teaching and Learning (maximising our investment in Australian schools)

Response to written questions on notice

Professor Geoff Prince and Ms Janine McIntosh Australian Mathematical Sciences Institute

1. Should mathematics be made a compulsory subject for all senior high school students, and be counted towards all year 12 final scores?

Though we would like all Australians to be numerate and to have adequate mathematics for their chosen career, we do not support mandatory mathematics for all year 12 students. There are two reasons for this:

- . We believe that universal compulsion might further increase the negative perception experienced by some students who might not otherwise choose mathematics.
- . Australia does not have adequate teachers with the qualifications to teach the current students of mathematics in secondary schools, more students would only increase the pressure on the existing workforce.

We do favour compulsory mathematics to Year 11.

Having said that, there are a number of groups for whom school mathematics to year 12 should be a compulsory prerequisite:

- . University students including those wishing to undertake courses in science, psychology, medicine, nursing, engineering, architecture should have at least one calculus-based subject at year 12.
- . TAFE students, especially those who wish to undertake a trade such as electrician, builder, carpenter or plumber should undertake maths at, at least, the most basic level at year 11 and 12.
- . Primary teachers. Prospective primary teachers must have a year 12 mathematics subject (not the terminal "Essential mathematics" subject in the new Australian curriculum). This will help ensure that mathematics is taught across the primary curriculum in a sound manner.

We would like to see the mandatory participation of students in robust career programs at years 10 to 12 that demonstrate the value of mathematics in many careers. This would require coordinated professional development for careers advisors and for mathematics teachers.

2. You've recommended that there should be a body that collects national data on secondary mathematics teacher graduation rates, and the profile of teachers who are maths teachers. Would any existing bodies be appropriate to should collect this data? Do any states currently collect this data? [AMSI, Submission 11, p. 11]

The States do not currently collect this data. In our opinion, AITSL or DEEWR should collect and manage the data.

3. I'd like to ask you about your relationship with universities.

*** Have you expressed to university deans your concern about the ability of primary school teachers to teach mathematics? In what forum? What was their response?**

We have not formally approached the Deans of Education on this matter but we have had conversations with individuals and they have been in receipt of some of our submissions on the matter. Unfortunately we find our supporters amongst those already addressing the issue.

AMSI Director, Professor Geoff Prince has made presentations to the Australian Council of Deans of Science and to the Deans of Engineering on teacher training and supply issues. Both groups were sympathetic to the need for more suitably qualified citizens with mathematical training. Most felt that the decision to remove mathematics as pre-requisites was largely out of their hands.

AMSI convenes an annual meeting of the Australian Council of Heads of Mathematics and Statistics (ACHMS) and provides secretariat support in order to facilitate robust discussion around this issue among others.

Heads of mathematics and statistics departments from all over the country, the president of The Mathematics Education Research Group of Australasia (MERGA) and the president of the Australian Association of Mathematics Teachers (AAMT), the Bureau of Statistics and CSIRO are all represented on the ACHMS.

This group would welcome higher standards of mathematical content knowledge for primary teachers.

*** Have you considered how you can assist your members to build links with education faculties to ensure that first year students know what subjects they need to take to become maths teachers? [AMSI, Submission 5, p. 12]**

Yes, and we believe that a compact between the Deans of Education and the Deans of Science is the best way forward. In our experience measures led by individual mathematics departments are short-lived.

4. Citing the Productivity Commissioner, you've suggested that teaching programs should not be extended, but rather funds should be devoted to in-school professional development. Can you respond to arguments made by the University of Melbourne that its graduates feel better prepared for the classroom than teachers who are only one year trained? [University of Melbourne, Submission 20, p. 6 - 90 per cent as opposed to 40 per cent nationally]

This is a matter of the best placement of limited resources. The number of existing teachers teaching maths out-of-field vastly outnumbers those in teacher training in any one year and even over 10 years. Converting these individuals to effective teachers of mathematics will have far greater impact in the short and the long term.

Having said this we do have concerns about the implicit claim that a 2 year masters will make primary teachers better at teaching maths.

It is all very well for recent graduates to report that they feel more prepared, the reality may be that they feel more prepared, but are not. Janine McIntosh has taught in the University of Melbourne two-year masters (at a time when the university engaged sessional lecturers to cover their courses). The mathematical content knowledge of the primary teaching cohort was a little higher than in previous years under the old system of a four year undergraduate degree,

but there were still quite a number of poorly prepared teachers graduating with a less than acceptable standard of mathematics understanding and confidence. The worry here is that Melbourne University's course is considered to be one with the highest standards in the country. There are many primary teachers graduating from other universities who are quite wobbly on their legs mathematically.

Returning to the issue of teachers teaching out of area in secondary schools. It is our strong view that this is the one part of the mathematical pipeline where most can be done to ameliorate the teacher shortage. Teachers without mathematics and statistics majors continue to teach secondary school mathematics. These teachers often resort to teaching as they were taught, in the absence of good advice and adequate preparation and are less than competent to deliver the curriculum in an accurate as well as engaging manner. The needs are of this group are many.

To illustrate, we will describe an intensive program delivered with the precise aim of mending this gap in understanding. Though by no means a complete and sufficient program, we had some success after starting with a group of teachers from a very low base. In a ten week, (3 hours per week) program targeting the mathematics content needs of secondary teachers teaching mathematics without a mathematics major in the Geelong area in first semester 2012, Janine McIntosh tested the participating teachers at the start of the program. There were a number who had difficulty converting measurements in millimetres to centimetres, who could not perform the standard subtraction algorithm with two three-digit numbers and who could not convert $3/8$ to a decimal.

In the beginning of this course, 4 of the 17 participating teachers received an initial result of 11% on a test of year seven content knowledge of fractions, decimals and percentages. By the end of the program we moved this group up considerably, so that the lowest score was now 64%.

It is these teachers who need immediate intervention. The on flows would go some considerable way to filling the gap in the number of qualified teachers that are needed.

5. The government recently created the Office of the Chief Australian Scientist. Do you believe that this has assisted in promoting the status of science and mathematics in Australia?

Yes we do. We commend the decision of the Chief Scientist in appointing a national mathematics and science advisor. Indeed, we made this recommendation at the February 2012 AMSI Forum - Maths for the Future: Keep Australia Competitive <http://www.amsi.org.au/events/archived-events/773-maths-for-the-future-keep-australia-competitive>.

The Chief Scientist has been a great friend to the mathematical sciences since his appointment. He has been available to speak to students at AMSI flagship events, to launch the International Year of Mathematics of Planet Earth (January 2013) of which he is Australian Patron, and to be directly engaged in policy discussion with AMSI. He is by far the most visible Chief Scientist in recent times and he has had tangible effects on government policy.