



Public submission made to the Review to Achieve Educational Excellence in Australian Schools

Submitter: Australian Mathematical Sciences Institute
Submitting as a: Academic person or institution
State: Vic.

Summary

To address teacher confidence, low mathematics teacher numbers, weakening student participation in mathematics and mathematics related subjects and careers and poor public perception of mathematics AMSI makes the following recommendations:

Recommendation 1: Government and education stakeholders should continue to monitor PISA, TIMSS and NAPLAN data carefully.

Recommendation 2: Government investigate proposals such as that outlined for the quickest turn-around of teacher numbers in mathematics teaching for secondary schools.

Recommendation 3: Fund a national on-the-ground professional learning system for mathematics.

Recommendation 4: Government facilitate the collection and dissemination of data about teacher qualifications and teaching loads.

Recommendation 5: Government undertake an informed national campaign enlisting the expertise of education and behaviour change experts to encourage more students to 'stick with maths'.

Main submission

Introduction

As a lead organisation for Mathematics in Australia, the Australian Mathematical Sciences Institute is well placed to make comment and provide advice pertaining to the teaching and learning of mathematics.

Our staff are comprised of mathematicians and statisticians, teachers (both primary and secondary) and allied professionals including business, marketing and design staff.

The AMSI mission:

The radical improvement of mathematical sciences capacity and capability in the Australian community by:

- supporting high-quality mathematics education for all young Australians
- improving the supply of mathematically well-prepared students entering tertiary education by direct involvement with schools
- supporting mathematical sciences research and its applications including cross-disciplinary areas and the public and private sectors
- enhancing the undergraduate and postgraduate experience of students in the mathematical sciences and related disciplines

With AMSI's main brief in mind, we focus on Mathematics alone in this submission.

What should educational success for Australian students and schools look like?

- What capabilities, skills and knowledge should students learn at school to prepare them for the future?

The Australian Curriculum Mathematics sets the content for students at each level. Every Australian child should be afforded the skills and knowledge for Year 10, that is they should have completed their compulsory years of schooling in mathematics with a robust understanding of the content for health and wealth in their life, analysing data in their work and for their leisure and to support them as functioning citizens.

AMSI is experienced at delivering professional learning and schools support so that teachers and students can attain their potential. We see many examples of deficit skills and knowledge and a great deal of low confidence in mathematics especially in teachers teaching 'out of area' in the secondary school and in a number of primary teachers.

In our view, it is also desirable to have every child leave school with a positive attitude towards mathematics. Negative attitudes are passed on and absorbed by those around us. The infection of negative attitude towards mathematics as a life skill is endemic in this country and much needs to be done to turn this public perception around. To this end AMSI works towards public awareness of the value and importance of mathematics through campaigns providing information to aid in decision making.

- How should school quality and educational success be measured?

Every child starts school with mathematical potential. We can think of mathematics as a pipeline through school, tertiary education into the workplace. At points along the pipeline, different factors choke the outputs. The result is fewer maths graduates and fewer mathematics-capable citizens.

The two international comparisons of student performance in the mathematical sciences, the Organisation for Economic Co-operation and Development (OECD), Programme for International Student Assessment (PISA) study and the Trends in International Mathematics and Science Study (TIMSS), show a decline in Australia's international ranking. Though Australian students generally perform above the international average, the distance between that average and Australian performance is falling and a number of countries have overtaken Australia by significantly increasing their mathematics performance.

The performance in the NAPLAN numeracy tests varies over time within each school year levels and between boys and girls. On average, boys score higher than girls consistently. The average gender difference in performance, was approximately 7.4 points in Year 3 tests in 2008. It jumped by 43% to 10.6 points in Year 5, and remained at a similar level in Years 7 and 9. The 95% confidence intervals of the gender difference in 2008 at all year levels provided by NAPLAN are statistically significant. From AMSI analyses of the data, the girls' average is very likely to be significantly below boys' average in every school year and calendar year.

AMSI monitors such data carefully through its annual Discipline Profile of the Mathematical Sciences.

Looking at Year 12 mathematics participation rates it becomes clear that a large proportion of Year 12 students study at least some mathematics, but that the number of students choosing intermediate and advanced mathematics subjects (the pre-requisites for STEM careers) has been in decline for some time, with girls participating at lower rates than boys at the advanced level. The drivers for this decline in participation include the absence of mathematics as a university pre-requisite for a number of courses.

The rate of participation of women in mathematics in Australia is significantly less than for men. Australian undergraduate and higher degree in mathematics enrolment by men is at about half the OECD average, and by women it is one-third. The increase in mathematics-related PhDs needed by 2020 to satisfy overall demand is projected to be 55% more than that of 2007. Recommendation 1: Government and education stakeholders should continue to monitor PISA, TIMSS and NAPLAN data carefully.

What can we do to improve and how can we support ongoing improvement over time?

Nothing can be achieved without good teachers of mathematics. In the AMSI Policy Document: Improving Australia's Maths Grades, we outline the steps needed across the mathematics pipeline. <http://amsi.org.au/wp-content/uploads/2017/10/improving-australias-maths-grades-2017-web.pdf>

Australia does not have a full complement of qualified secondary mathematics teachers. Of the students in Years 7 to 10 in Australian schools, 40% are being taught by teachers who are 'teaching out of field'. These teachers are qualified to be teachers, but their undergraduate course was not in mathematics or did not contain sufficient mathematics for them to undertake a method subject in their Diploma of Education.

AMSI proposes a solution to address the problem of Out-of-Field teaching in secondary school mathematics.

Proposal: set up a small working group on out-of-field teaching in mathematics

Plan from AMSI: provide pedagogy and content knowledge in strategic geographic areas to those teachers most readily upgraded in situ.

Period: 5 years

Participants: Commonwealth, school jurisdictions, universities

Provision:

1. Universities provide mixed delivery, tailored Graduate Certificate and Graduate Diplomas individually or collectively, State by State.
2. Jurisdictions choose eligible regions/schools and roll out timetable and set eligibility criteria for teachers (avoids semi-public audit)
3. Commonwealth and jurisdictions agree on cost sharing to subsidise HECS/fees.

Teachers:

1. Will stay in their schools for 3 years after completion
2. Will pay HECS/fees if they don't complete or leave their school
3. Will receive a salary loading during and after completion for 3 years
4. Ineligible teachers can enrol but with limited incentives.

Examples:

A teacher in Victoria's Goulburn Valley has a Biological Sciences degree and a Dip. Ed. (General Science and Biology Methods) from La Trobe University. She has first year Biostatistics and Maths and Computing for Biology with no second year maths or stats. She is teaching Year 10 Mathematics and Year 12 Further Mathematics because the school has insufficient trained maths teachers and no maths graduates following a recent retirement. The Year 7 teachers have no university maths. There is poor retention of these teachers and the Principal cannot fill vacant maths positions.

She enrolls in a Graduate Certificate over two years and takes two second year maths and stats subjects at La Trobe for which she has the first year pre-requisites along

with a dedicated “maths for teachers” subject at the University of Melbourne and a maths pedagogy subject. She studies for two years (2 subjects a year online with some face to face contact and stays at her school for a further three with enhanced promotion opportunities. She is retained in the Goulburn Valley for the “magic” 5 years.

Her colleague, a male English teacher who is teaching Year 7 maths, is ineligible but is relieved of the burden in another two years because the school is now retaining maths teachers because critical mass has been achieved. He is supported during that time through AMSI’s in-school professional development program funded, in part, by the Victorian Government, the Commonwealth, or a funding partner such as BHP.

Recommendation 2: Government investigate proposals such as that outlined above for the quickest turn-around of teacher numbers in mathematics teaching for secondary schools.

- How could schools funding be used more effectively and efficiently (at the classroom, school or system level) to have a significant impact on learning outcomes for all students including disadvantaged and vulnerable students and academically advanced students?
 - What actions can be taken to improve practice and outcomes? What evidence is there to support taking these actions?
 - What works best for whom and in what circumstances?

Teachers need robust, sound professional pre-service teaching in mathematics and then ongoing and sustained professional in-service learning to support the teaching and learning of mathematics in Australian Schools.

Recommendation 3: Fund a national on-the-ground professional learning system for mathematics.

- What institutional or governance arrangements could be put in place to ensure ongoing identification, sharing and implementation of evidence based good practice to grow and sustain improved student outcomes over time?
- How can system enablers such as targets and standards, qualifications and accreditation, regulation and registration, quality assurance measures and transparency and accountability provisions be improved to help drive educational achievement and success and support effective monitoring, reporting and application of investment?

It is important to understand the problem. At this point, there is no jurisdiction in the country that collects and reports on accurate data about the number of teachers teaching mathematics out of area in secondary schools. Teacher registration boards/institutes in each state and territory do not collect this data.

In most cases a teacher completes their undergraduate degree and a postgraduate qualification to teach. The undergraduate degree may identify them as a science or maths teacher, but once they have completed their postgraduate teaching qualification they are 'counted' as education graduates.

Recommendation 4: Government facilitate the collection and dissemination of data about teacher qualifications and teaching loads.

- Are there any new or emerging areas for action which could lead to large gains in student improvement that need further development or testing?
 - What are they and how could they be further developed?

Public awareness campaigns have had success in changing public perceptions about mathematics. The 'Maths Multiplies Your Choices' campaign in the 80s (and reviewed in 1991 by Kathryn McAnalley, Manager Education, training and Employment Programs, Youth Guarantee Branch, Department of Labour) had a positive impact on the number of young women selecting mathematics at senior school and undergraduate tertiary level.

AMSI is currently undertaking a national careers awareness campaign.

The 'I am more than a number' campaign had consisted of two phases, the direct mail poster campaign that landed in school's nation-wide in May of 2017 as well as the series of profile videos due to launch in November.

The poster pack included profiles of thirteen CHOOSEMATHS Ambassadors, showcasing careers in maths across industry sectors from medical research, coding, and engineering to indigenous astronomy and mineral and resources. The stories shared by the careers ambassadors highlight that maths is available to everyone and is a powerful gateway to many career pathways.

The posters, coupled with other careers collateral can be used in classrooms and by careers advisors to highlight to students the varied careers that exist in maths.

The CHOOSEMATHS major national advertising campaign launched in August 2017 to coincide with University Open Day messaging, and the opening of preference choice for 2018 university courses and Year 11 and 12 subject selections. The campaign included a strategic national digital presence on Fairfax and News Corp news streams and social media advertising on Facebook, Twitter and through high-reach individual influencers. The campaign was also supported by a major physical advertising campaign on public transport in Sydney, Perth and Melbourne.

More of this is needed.

Recommendation 5: Government undertake an informed national campaign enlisting the expertise of education and behaviour change experts to encourage more students to 'stick with maths'.

Are there barriers to implementing these improvements?
If yes, what are they and how could these be overcome?