

Decadal plan – AAMT draft submission for comment

Summary of key points and recommendations

Increasing the quality and effectiveness of pre-service teacher education in mathematics is important. However, over the next 10 years, investment in the existing workforce will yield the most gains for students and the country as a whole.

Two types of achievement gaps must be addressed. These are the gap between the low achievement of groups of students (particularly Indigenous, low SES and rural students) and the general population as found in, for example, NAPLAN, TIMSS and PISA; and the gap between the achievement of most students and what they are capable of achieving – many students underachieve in mathematics. Without sustained and research-informed action on both of these the future of the mathematical sciences in Australia will remain bleak.

Supply of suitably prepared teachers of mathematics

There should be urgent review and extensive reform pre-service education of teachers of mathematics (primary and secondary) by both the Mathematics and Education faculties of all relevant universities.

Employers of beginning teachers and the profession itself should collaborate to establish a career structure and associated processes that halve the attrition rate of current teachers of mathematics.

Closing achievement gaps

This is core work for teachers of mathematics. A range of national initiatives is required, including: extensive in-service professional development; quality teaching and assessment resources; research targetted at informing classroom teaching; support for principals and in-school leaders in mathematics; and a mathematics-specific system of standards and credentialling for teachers of mathematics that is part of a coherent career structure.

Australia should establish a systematic and supported program that enables and encourages all parents to have daily mathematical engagement with their children.

Increasing the numbers of students studying advanced mathematics at senior school

Significant reform of school mathematics is essential, including further reducing the amount of content to achieve 'greater depth' in all students' learning of the subject.

Set and monitor benchmarks for every student's opportunity to learn mathematics including challenging and engaging teaching; time for learning mathematics; technologies for learning; qualified teachers and accredited leaders of mathematics in the school; and commitment to and extra support for the professional development of teachers of mathematics

Introduction

AAMT views the issue of ‘achievement gaps’ (Section 2) as pervading both the other sections. Inadequate supply of appropriately qualified and prepared teachers of mathematics (Section 1) is on effect of many students underachieving in mathematics; greater numbers of students in the higher level mathematics subjects in the senior years of schooling (Section 3) will be a significant benefit from addressing underachievement in mathematics. Hence, achievement gaps require substantial and sustained effort over the next ten years, both in their own right (as outlined in Section 2) and for the consequential effects in the other two areas.

AAMT identifies two types of achievement gap. These are the gap between the low achievement of groups of students (particularly Indigenous, low SES and rural students) and the general population as found in, for example, TIMSS and PISA; and the gap between the achievement of most students and what they are capable of achieving – many students underachieve in mathematics.

The first of these have been a focus for government funded programs for many years, most recently through the national partnerships funding. This focus is likely to continue under the Gonski inspired changes to school funding. The intention is wholly appropriate. What is clear from the persistence of the issues is that new and better ways of applying available funding are required.

The second type of achievement gap is widespread across different groups and represents a significant waste of human capital. Again these gaps are evident through international comparisons. They have also shown themselves to be substantial and resistant to efforts to close them.

Both the breadth and depth of the issues facing school education in mathematics that result in, among other things, achievement gaps, have intensified in the past 10-20 years. This is despite good intentions, some funding and effort over that time. Many approaches have been tried and found wanting, with some of these recycled a few years later. In other cases, successful initiatives have not been extended or sustained. Hence AAMT believes that, in the case of school mathematics, a coordinated plan for the next 10 years (this Decadal Plan) that results from consensus in the mathematical sciences community will provide a strong framework for addressing entrenched issues.

AAMT believes that new thinking is required. Failed or ineffective strategies must not be used, no matter how appealing they may be to sectional interests.

(successful reform) requires investment in the present teacher workforce, providing quality professional development, adequate career structures and diversification, and enlisting the commitment of teachers to reform. The frequently cited claim that the best-performing education systems all recruit their teachers from the top-third of graduates ... is not supported by the evidence. Successful reform cannot wait for a new generation of teachers.

OECD. 2012. *Preparing Teachers and Developing School Leaders for the 21st century – Lessons from Around the World*. Paris: OECD.

1. Strengthening the supply of teachers

1.1 Preamble

Beginning teachers of mathematics in primary and secondary schools in 2025 will enter university in 2020 or 2021. They are currently in Year 5 or 6. For nearly half of the next decade those who will become teachers of mathematics are already in university – the rest will pass through university on their way to becoming teachers of mathematics in the decade.

Hence the need for reform is urgent – Australia must do better with young people who are in the ‘system’ now.

1.2 Direct entrants to teaching (people who go from school to university and into teaching)

The factors that result in a young person deciding to become a teacher of mathematics include:

- success in mathematics at school
- a positive self-image as someone who is ‘good at maths’
- good role models – experiencing good teachers themselves
- a vision that the career would be rewarding
- a desire to contribute to the education of young people

Creating the conditions that encourage and enable school students to view teaching mathematics as a worthwhile pathway can, to a very large degree, only be addressed by urgent attention to the second (achievement gaps) and third (numbers of students in senior school mathematics) major issues discussed below.

Turning the intention to being a teacher of mathematics into reality requires:

- gaining entry to university with a sufficient level of mathematics in their schooling
- success in the mathematics studied at university
- success in the mathematics education and general education courses studied at university, including the Practicum components
- positive reinforcement that it is a rewarding pathway through practicum experiences and other means
- finding worthwhile employment

Over the next 10 years Australian universities and teacher employers need to undertake important reforms.

- Education Faculties should undertake an urgent review and reform of the university education of teachers of mathematics, including entry criteria (especially for primary teachers), curriculum, teaching practices and assessment in mathematics subjects, mathematics education and general education subjects, and teacher practicum
- Mathematics Faculties should undertake an urgent review of the university education of teachers of mathematics, including curriculum, teaching practices and assessment in mathematics subjects
- The cycle of short term appointments for early career teachers of mathematics should be replaced by thoughtfully constructed and adequately funded initial career placements that provide stability and predictability.

Some 30% of new teachers leave the profession in the first five years. Reasons for teachers leaving the profession include:

- uncertain, limited or inappropriate career prospects

- a sense of not being valued
- dissatisfaction with the work of teaching mathematics
- taking a different – and possibly more secure and/or lucrative – career pathway
- personal reasons

Over the next 10 years Australia should reduce the attrition of early career teachers of mathematics by at least 50%.

- The reform to the career structure for teachers of mathematics outlined above is relevant here, and needs to extend for at least the first five years of their career
- The profession – not employers – should provide early career teachers with mentor support, among a suite of programs that are effective in welcoming early career teachers on mathematics into the mathematics community.

1.3 *Alternate pathways into teaching*

- In recent years programs such as Teach for Australia and Teach Next have sought to attract high achieving graduates and fast-track them into the classroom through an ‘apprenticeship model’ of teacher education. The numbers of teachers of mathematics in these programs has been and will remain small. Hence these programs are not relevant to considerations of supply of teachers of mathematics.
- As alternative pathways into teaching mathematics, however, it may be that some of the approaches can be used in the transformation of teacher education outlined above.

1.4 *Career change entrants into teaching (people with appropriate qualifications with an established career who choose to take up teaching mathematics)*

Tapping this pool of prospective teachers of mathematics has the potential to address shortages in supply in the (relatively) short term. Factors that would make such a career change attractive would include:

- a positive self-image as someone who is ‘good at maths’
- a vision that the career would be rewarding
- a desire to contribute to the education of young people
- a perception of teaching as a family friendly career

Key among the factors that discourage such a career change are:

- loss of income whilst obtaining the necessary education qualifications – many of these people would have significant personal financial commitments
- uncertain, limited or inappropriate career prospects, especially for those who would be giving up an established career

Over the next 10 years Australia should maximise the appeal and uptake of career change into teaching mathematics by suitably qualified individuals.

- Aspects of the approaches taken for alternate pathways into teaching may be explicitly adaptable for these career change entrants
- The restructuring of career structures and the development of a culture of the profession welcoming entrants and associated processes would be appropriate for this group and would serve to address inhibiting factors

2. Closing achievement gaps

AAMT believes that the achievement gaps evident in Australian school mathematics requires effort and major reform in two areas. These are the *Quality of teaching* and *Parental engagement*. Fundamental to these initiatives and reforms is that the orientation that all young people can learn mathematics is held and reinforced by parents, teachers and other educators, and, most importantly, the young people themselves.

2.1 Quality of teaching

Many teachers of mathematics in primary and secondary schools are currently doing outstanding work. An emphasis on improving the quality of teaching needs to acknowledge and respect this, and build on the store of capacity these teachers bring to their work.

- The bulk of students in schools in 10 years time will have been taught by teachers already in schools or in the current 'system' of teacher preparation.
- Hence closing the gaps will be dependent on improving the quality of the teaching of people who are past their initial pre-service teacher education.
- Current in-service teachers need to build their professional capacities to close achievement gaps, including both for those students currently achieving poorly in mathematics as well as for those students who perform adequately, but who could do much better.
- The factors that influence the quality of teaching mathematics include:
 - an orientation towards clear focus on the proficiencies and higher order thinking skills
 - mathematics content and pedagogical content knowledge of teachers in relation to the students and the curriculum they are teaching
 - teachers' access to and use of professional support including teaching and human resources
 - the educational leadership of teachers' 'work units' (typically department or faculty in secondary school; school or year group etc. in primary)
 - the system of professional standards and credentialling

Each of these require significant and sustained effort.

Over the next 10 years, Australia needs to expand the funding and effort applied to mathematics teaching through national programs that are targetted to improving the quality of the teaching of mathematics. :

- A national program of in-service professional development that helps teachers develop their knowledge of mathematics and their pedagogical content knowledge in mathematics that supports enhancement of their teaching practices. This program needs to be innovative, cost effective, targetted in building teacher capacity. It should build on partnerships between the professions, universities and others.
- Build on the current *Supporting the Australian Curriculum Online* (SACOL) project and extend this approach with targetted projects to enhance the quality of resources available to and used by teachers.
- Either as part of the two previous initiatives or separately, to design and provide resources and systems for teachers of mathematics to learn the mathematics content they need to know for their teaching as they need it ('just in time').
- A national program carefully constructed sample studies that interrogate issues in students' learning of mathematics than is possible with current instruments (NAPLAN, TIMSS and PISA). Students' 'multiplicative thinking' and notions of 'variable' are two examples of important mathematical areas that would benefit from these kinds of sample studies. Such

studies will inform teachers, schools and education authorities with an evidence base of the detail about student achievement and where and how they can take targeted action.

- A national program to develop instruments and means for teachers to make informed, professional decisions about important aspects of students' learning that are not able to be assessed using the sorts of tools that are currently in place for the large scale, high status assessments. Until and unless teachers' professional judgements are supported by good quality materials, and processes that generate confidence in them, the importance and value of teachers' professional judgement will be discounted in considering students' 'achievement' in mathematics.
- A national program for in-school curriculum leaders in mathematics that equips them to succeed in their role (may be a part of the overall in-service program above, but its purpose will be to provide the knowledge and skills to enable these people to be effective leaders in mathematics).
- A national program that provides principals with the knowledge and skills to lead their school's work and development in mathematics, and the expectation that they will play a strong and sustained leadership role in mathematics.
- Build on AAMT's established work on professional standards for teaching mathematics to create a full system of standards and credentialing that are directly related to the work of teaching mathematics. The standards need to talk to the teaching of mathematics through specifics. (Note that the AITSL Standards and associated processes are not considered 'fit for purpose')

The current levels of localisation of curriculum, resources, teacher support and assessment processes by the state and territory jurisdictions militates against maximising the advantages of having a common national curriculum and should be dismantled.

2.2 Parental engagement

The value of direct engagement of parents in their children's schooling is well established as a general principle. For mathematics, significant gains could be made in addressing achievement gaps through enlisting parents as partners in their child's learning of mathematics.

In the area of reading, parents are encouraged to regularly read to and with young children. There have been some positive initiatives in the area of parental engagement with their children's learning of mathematics over recent decades, but these have been quite school dependent and there is no evidence of widespread uptake of parents doing and talking mathematics with their children as part of the 'culture' as has been the case for reading.

A number of factors would need to be addressed in any attempt to have parents focussing on mathematics with their children. Important among these are:

- parents' fear of mathematics – many adults have poor self-perceptions of themselves in mathematics from their own school experiences, and can tend to avoid mathematics with their children
- parents' views of what is important in mathematics – parents can feel at odds with contemporary approaches to learning mathematics being used in schools, given that these are not what they experienced
- providing stimulus ideas and starting points for activities and conversations for parents – until parents have some experience, they will need this sort of support.

Over the next 10 years, Australia needs to establish a systematic and supported program that enables and encourages parents to have daily mathematical engagement with their children. Whilst this should be delivered through individual schools, the materials and processes should be of high quality and be based on best available research in the area. Particular attention will need to

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be provided to the needs of parents in low SES settings as they may need additional information and support to be able to play a positive role in their child’s mathematical development.

3. Increasing the numbers of students studying advanced mathematics at senior school

3.1 Preamble

- The students in their final year of schooling in 2025 have already commenced their schooling.
- There is clear evidence that young people can be ‘turned off’ mathematics as early as the middle primary years. Certainly being ‘turned off’ mathematics (“I am no good at maths”, “Maths is only for the nerds and brainy kids”, “Maths is hard” and “The maths we learn isn’t relevant to me” etc.) reaches epidemic proportions in the junior secondary years.
- Hence mathematics has an ‘image’ problem that requires action on several fronts:
- The amount of mathematics to be learnt – the AuC:M has gone some way to decreasing the overload in content that all students need to learn. However, the expectations in F-10 for those students on a pathway to taking advanced level courses in the senior years are largely unchanged, thanks to the inclusion of 10A content. In the senior years the advanced level courses have consistently been criticised for containing too much content, and much that is ‘too hard.’
- The nature of the mathematics to be learnt – very little (if any) of the mathematics content in the AuC:M draws from ‘contemporary’ mathematics and its uses. For example, in our digital world, codes and encryption cry out for inclusion in school mathematics. This and many other areas of mathematics can and should be treated appropriately in schools. Inclusion of these topics would help address the key issue of relevance and connection.
- The way mathematics is taught and learnt – through consistent good teaching, many students currently experience mathematics as an exciting, interesting and challenging subject. For others this is the case occasionally or not at all. The overcrowding of the curriculum clearly contributes to teachers resorting to teaching approaches best characterised as very traditional.
- Articulation of the importance of mathematics to many career options – many students and their parents recognise that mathematics is important for young peoples’ futures, but see that as being relevant for others, not for them/ their child. Allied to this is that many adults represent the unhelpful view that they were “not good at mathematics” with the implication that it is acceptable for their children to be likewise.

Over the next 10 years, Australia needs to:

- Engage and enlist the support of parents, business and the wider community for urgent reform of mathematics in schools.
- Further reduce the amount of content in the mathematics curriculum for students on all post-school trajectories.
- Set targets for the inclusion of new content drawn from contemporary mathematics and its uses through further reductions in the amount of currently included content. These changes to content will require a renegotiation of the entry expectations for STEM courses at universities and for some technical trades.
- Establish benchmarks for every student’s opportunity to learn mathematics, and have a positive experience learning mathematics:
 - the commitment of the whole school to teach mathematics that is challenging and engaging
 - time for learning mathematics
 - access to, and expectations to use, technologies in their learning of mathematics
 - a teacher who meets minimum standards for teaching mathematics at that level
 - an accredited leader of mathematics in their school

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- teachers with an allocation of a further 10% of their work time for accredited professional learning
- regular auditing of and reporting against these benchmarks in action at the individual and school level