



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

Submitter: The Australian Association of Mathematics Teachers Inc.
Submitting as a: Other (National Teacher Professional Association)
State: SA

Summary

The AAMT submission deals in detail with school mathematics, as the means for developing essential quantitative and reasoning skills and capabilities; some of these, and other matters apply to education more generally.

Mathematics

“Mathematics underpins all STEM” is common rhetoric. AAMT argues strongly that this needs to be enacted through much increased policy and program effort in mathematics at all levels. Continuing on current pathways will not be nearly good enough. Australia needs a comprehensive, long term (10 years at least), coherent, well-resourced national investment in mathematics teaching and learning.

Careful and sustained application of findings from the extensive body of Australian research in mathematics education, as well as further focussing of research effort through application in the STEM context can be the ‘game changer’. Greater focus on research findings in mathematics can show the way for building Australia's national evidence capacity to match the ‘culture’ of evidence based practices.

Education more generally

Further collaborative work is required to revise the goals of education – and curriculum and practice – to reflect students' current and future needs. Inherent in this is that assessment of student outcomes needs to be against 21st century capabilities, a shift that will require major developments in assessment to 'make assessable what is important, rather than making important what is assessable'.

Professional associations like AAMT and its Affiliates in each jurisdiction are a proven powerful resource to support the quality of teaching. Governments and others should form partnerships to extend professional associations' capacity to contribute to professional learning. This is an essential – and cost effective – strategy.

Main submission

Educational success

The recent Productivity Commission report “Shifting the Dial: 5 year productivity review” (released on 24 October 2017) makes a clear case for clearly focussing on a clear statement on this matter:

“Slipping school results and concerns about teaching quality raise questions about how Australians will adapt to the wave of changes in the economy over the coming decades.”

Further, the report cites two of the key indicators of this ‘slipping’ are related directly to the learning of mathematics:

- The share of Australians with poorest maths skills has risen the most among OECD countries 2003-2015 (p. 31)
- An Australian 15-year-old in 2015 had a mathematical literacy equivalent to a 14 year old in 2000 (p. 89)

Concerted and sustained effort to raise the quality of the teaching of mathematics and the learning of our young people must therefore be central to ‘achieving excellence’ in Australian education. Focus of STEM up till now has prioritised science and technology learning, and failed to systematically address the role mathematical understandings play in giving students real access and facility in STEM.

- Capabilities, skills and knowledge

At the broad level, students should exit their schooling equipped to be engaged and productive citizens and workers in the 21st century. Goal 2 of the Melbourne Declaration (2008) is for students to be:

- Successful learners;
- Confident and creative individuals; and
- Active and informed citizens.

AAMT sees these as a good basis for a current description of 21st century skills.

Nearly 10 years on, AAMT believes that a collaborative process is needed to further develop the thinking and practices stimulated by the Melbourne Declaration to reflect the current educational, economic and social contexts.

AAMT believes that quantitative and reasoning skills and capabilities – our specific area of interest – are essential components of 21st Century skills. Improved STEM skills have in the last decade been recognised as central to sustaining economic and social prosperity. This creates a strong case for an increased emphasis on quantitative skills in schooling – all STEM pursuits are underpinned by quantitative skills.

The term 'quantitative and reasoning skills' is used to convey a broader meaning than what might be inferred if we referred to 'mathematical skills', given that many would interpret this as meaning the only the traditional skills emphasised in school mathematics of the 20th century. The 21st century requires application of mathematical skills, and the dispositions and confidence to do so. Various terms are used to capture this – 'numeracy', 'mathematical literacy', 'statistical literacy', 'quantitative literacy', 'mathematical modelling'. Whatever they are called, these skills, understandings and orientations are also essential to the development of critical thinking, creativity, communication, resilience and persistence.

In its contributions to any revision of the National Goals, and otherwise, AAMT will strive to bring greater clarity to the description of quantitative skills and reasoning for the 21st century. In doing so, the Association will draw on findings from previous research and development initiatives.

The project Identifying and Supporting Quantitative Skills of 21st Century Workers (AAMT and AIGroup; 2014) identified the mathematical demands placed on young workers in contemporary workplaces. It concluded:

"The application of mathematics in the workplace is not straightforward and goes beyond a command of 'core' or basic mathematical content. Workers perform sophisticated functions which require confidence to identify, use and apply mathematical skills in problem-solving situations and knowledge of the consequences of the procedures. Workers need a blend of the following:

- ability to recognise and identify how and when mathematics is used in the workplace;
- an understanding of mathematical concepts, procedures and skills;
- an understanding of the kinds of practical tasks they need to perform; and
- the strategic processes they should be able to use in using and applying mathematics."

Another project that directly addresses a shift in mathematics curriculum towards quantitative skills, mathematical modelling and STEM is Maths Inside. Led by a team at the University of Technology Sydney working in partnership with AAMT and CSIRO, Maths Inside has produced:

- eight video case studies of leading edge CSIRO scientists talking about their work, and the central role mathematics plays – in diverse fields including prawn farming, nutrition studies and radio-astronomy;
- 33 sets of classroom materials that use the work of these scientists as the springboard for high quality, relevant learning in mathematics for years 7-12 that is directly related to the Australian Curriculum; and

- Professional development programs to support implementation.

Maths Inside is ripe for scaling up, both by taking the existing resources to teachers across the country and by exploring more contexts in science and industry where mathematics plays a vital role. The approach is unique in that it marries mathematics curriculum with career awareness and inspiration in ways that are consistent with students' contemporary needs in both areas.

These initiatives and findings are indicative of the outcomes of a strong investment in research over the past 30 years in understanding 'what works', especially around identifying factors that support and block children and young people's development of strong mathematical understandings.

- Measuring success and quality

AAMT takes the view that 'school quality' is about the collective achievements of the students; while 'educational success' relates to the individual students. Measures of student outcomes are therefore the determinants of 'school quality' and 'educational success'. Given the broadening of student goals in general and for mathematics in particular, the means for assessment of how well students achieve those goals needs to be broadened to match.

NAPLAN Numeracy is a useful measure, but relatively narrow in its focus. It does not, and does not claim to, assess many of the sorts of attributes seen as critical for today's students. It is AAMT's view that there needs to be significant effort to develop more sophisticated assessment in mathematics. The aim should be to make measurable what is important rather than make important what is measurable. Capabilities such as problem solving, communication and teamwork are critical to doing mathematics and applying quantitative skills in today's world. Teachers, schools and education authorities need tools that enable careful and authoritative assessment in these sorts of domains.

Whilst AAMT's work relates to mathematics and quantitative and reasoning skills, it is likely that this broadening of the focus and practice of assessment is needed in other areas of learning; it is certainly necessary for measuring students' attainment of the generic 21st century skills. These new tools are likely to emphasise valuing teacher judgements, with the corollary that significant effort needs to be invested in informing those judgements to make them as good as they can be.

Improve and support improvement

- How could schools funding be used more effectively and efficiently

The current government has "Improving the quality of teaching and school leadership" as one of its five focus areas. AAMT supports this emphasis. Further, we argue that the focus on teaching and leadership underpins other foci on student performance, preparing them for a globalised world, and achieving equity.

In terms of the quality of teaching we note the finding from Hattie's work that the factor that has by far the most impact on student learning is the *efficacy of the teaching group*. This leads us to the view that there needs to be a relentless emphasis on creating outstanding groups of teachers. The locus for support and action therefore needs to be at the school or cluster level.

The important role of school principals in this is well-established. They need to create the conditions, support and expectations to help make their teaching group as good as it can be, striving to learn to do better. In practice, principals generally delegate day to day leadership of teams of teachers in the school to 'middle managers' (Assistant Principals, Coordinators, Heads of Department etc.)

AAMT and its state and territory Affiliates see supporting these 'middle managers' in mathematics as a strategic means to help them successfully lead their teams. One key mechanism being put in place (to be launched in December) is the Dimensions portal of professional learning resources. The materials are being developed by leaders in mathematics education – some of the most respected people in the country – are designed to share their expertise with school-based mathematics leaders. The packages allow these local mathematics leaders to bring state of the art professional learning content and processes to their group. Ample support is provided to enable the leaders to facilitate their colleagues' learning. They do not need to be 'experts' in everything themselves (this is not possible), or to engage an external 'expert' for face to face input (thereby making a considerable saving).

More broadly, mathematics teacher associations can play a vital role in supporting excellence in the teaching and learning of mathematics. The National Professional Development Programme was a Commonwealth funded initiative in the mid-1990s. The evaluation of that project found that every dollar of funding to professional associations to provide professional development for teachers created between two and four times as much in terms of actual value. Hence governments (state and national) and other agencies benefit from a significant 'multiplier effect' if they engage and fund professional associations to provide teacher professional development.

A current example of this multiplier effect is the Champions' program of the reSolve: Mathematics by inquiry project being coordinated by AAMT. Around 300 teachers and others have volunteered to undertake a training program that prepares them to 'champion' the exemplary resources created by the project in their work to lead the professional development of colleagues. The training program will take at least 60 hours of the Champions' out of school time. This means that the dollar cost of the program to the project is about one quarter of what it would be if the teachers' time was funded through release from teaching duties. Professional associations like AAMT are uniquely positioned to draw on these sorts of voluntary professional contributions.

- Institutional or governance arrangements

AAMT has commenced a collaboration with Social Ventures Australia (SVA) on its Evidence for Learning initiative. The aim is to elaborate the Evidence Toolkit in mathematics in order to provide teachers and schools with more specific guidance that is based on sound evidence from existing research on mathematics education, particularly from Australia.

There has been substantial research in mathematics education in Australia over many years and therefore much to draw on to inform teachers and schools. However, explicit attention to measuring the impact on student learning has not been a focus in much of the work, at least in citable publications.

This leads AAMT to the view that there needs to be a concerted effort to improve the rigour of the evidence bases developed by mathematics education research. The detail of what and how that can be done will need careful consideration in order to create a national 'evidence capacity' that, in the longer term, will create a credible and defensible system of evidence and advice that teachers and schools can use with confidence.

Such an orientation to the purposeful design of research to generate authoritative evidence may well be needed throughout education; AAMT is certain that it is needed, and needed urgently, in school mathematics.

The current collaboration with Evidence for Learning will continue. Our intention is to work with acknowledged leaders in the field to create 'best available' evidence bases and related advice for teachers in key areas in the teaching and learning of mathematics. This pilot will create a resource that is useful in the field. It will also identify means for extending into other areas of mathematics. Most importantly, we expect that it will point to the practices that can be the subject of studies to generate evidence that fits the rigour required by Evidence for Learning as part of building the national evidence capacity.

- System enablers

AAMT's submission to the Teacher Education Ministerial Advisory Group (TEMAG) argued for a coherent, collaborative approach to teacher support in mathematics:

"a well-designed and coherent system of support for quality teaching of mathematics that includes quality pre-service, good mentoring into the profession, early career support, ongoing support, targeted initiatives that address particular issues, mature professionals 'giving back' to the profession."

AAMT Submission to TEMAG, p.5.

We assert that the current approach to support for, and accountability of, teachers of mathematics throughout their careers consists of disconnected parts that lack

coherence and purpose, and envisage a solution in which, as in other professions, teachers of mathematics progress through a connected system that marries provision of support and purposeful, relevant continuing professional development with accountability against profession-driven standards and credentialing processes. AAMT has given this the title “Certified Teacher of Mathematics System”.

The founding and subsequent operation of the Certified Teacher of Mathematics System would reflect the following undertakings:

- ownership of the system rests with the profession – as is the case in other strong professions (engineering, accountancy, medicine);
- commitment to genuine collaboration between all stakeholders, based on acceptance of the urgency to act in a decisive and sustained way;
- rigorous quality assurance of preservice and in-service programs of all kinds to ensure they meet agreed standards for quality and relevance in mathematics;
- support for teachers of mathematics is a career-long responsibility;
- engagement with professional learning to improve skills in teaching mathematics is a career-long expectation of all teachers of mathematics; and
- mathematics specific standards for teaching are the framework for defining professional needs as well as being essential for accountability and recognition for all teachers of mathematics.

AAMT can elaborate its thinking and design for this as needed. The initiative is consistent with the approaches to developing pathways and recognition of highly accomplished and lead teachers, through the agreed national teaching standards (AITSL).

Given the universal acceptance that the quality of teaching must be a primary goal, nothing short of a radical re-engineering of the careers of mathematics teachers will be sufficient. The current attrition rates of early career teachers needs to be addressed as a matter of urgency. Mentoring Graduate Teachers needs to be addressed in a systematic and purposeful way, with professional associations playing a major role – efforts in this area can be the first stage of this re-engineering.

- New or emerging areas for action

Whilst it is not a ‘new’ area for action, the place and use of information technologies in schooling remains a continuing issue, and one on which many schools need guidance. There is a clear need for greater leadership and staff development in IT so that schools and students can realise its value both as tools to support and improve

mathematics learning, and as tools that are fundamental to the power of contemporary mathematics.

AAMT views any action in this area as integrated with our argument for the singular, relentless and intense focus on leading mathematics teaching and learning, not as a deflection from it. Done well, it will lead to large gains in student learning and support the overall development of greater levels of quantitative and reasoning skills in our society.

Greater sophistication in the use of IT as a tool for ongoing professional learning and engagement of leaders and teachers through approaches such as MOOCs, collaborative learning groups etc. is also needed.

The comments in the section on building the 'evidence base' (above; refers to the current collaboration between AAMT and SVA) identify building the 'national evidence capacity' are another area for action.

Barriers to implementing improvements

In terms of mathematics there is likely to be significant tension between re-envisioning the subject and its contribution to preparing young people for life and work and 'doing what we have always done'. This will be a factor internally (teachers) and externally (students, parents and the society as a whole). A sustained campaign is needed to help all stakeholders shift their views and values.

More broadly, there is generally narrow view of what constitutes assessment and legitimate evidence of students' learning. The move to assessing the domains seen as important for 21st century skills as suggested above will challenge existing views of assessment and is likely to be contested. Again, a sustained campaign is needed.

'Collaboration' and 'partnerships' are among the current catch cries in society, and this sort of orientation is a driver of the move in school education to focus on a broader set of capabilities and skills. It is therefore ironic that school education in this country in many ways reflects 20th century structures and thinking. We have eight separate jurisdictions that could work with each other – and other agencies such as professional associations – much more closely and collaboratively. However, they still hold onto their independence and autonomy to create difference when unity would be much more cost-effective productive in terms of student outcomes. The differential uptake of the Australian Curriculum is a good case in point.

Another significant barrier is the haphazard and start-stop nature of the funding to design and implement evidence-based approaches to improving the leadership, teaching and learning of mathematics. Promising or even proven approaches are not taken up – due to lack of resources and little attention to strategic planning for sustainable long term engagement – resulting in them rarely being taken to scale