



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

Submitter: "Maths Unlimited! A collaboration between Maths and Industry"  
Submitting as a: Other (A collaboration between Industry and Maths, see below)  
State: Vic.

### Summary

Maths Unlimited! believes that a radical increase in mathematics participation is key to a prosperous Australia. Mathematical thinking underpins all STEM disciplines. We believe that employees will need significant mathematics skills for success in the future workplace and to continuously drive innovation.

We have concluded that most Australians are largely unaware of the real value mathematics provides, and have a lack of understanding of what is possible with a mathematics-enabled education.

In order to arrest the 20-year decline in year 12 students studying intermediate and advanced mathematics, we propose a national awareness campaign to shift societal perceptions, and to raise awareness among parents, students, teachers, and career advisors of the opportunities and benefits that the study of mathematics provides.

Such an awareness campaign will also:

- Impact the opinions of the key influencers of students - namely, their parents, teachers, careers advisors and peers
- Encourage students to maximise participation and skill levels in mathematics, to increase their chances for future success
- Positively influence student subject choices through the senior years of high school, thus underpinning other STEM initiatives in schools, and beyond

Maths Unlimited! has developed a creative brief, and strategy, for the awareness campaign. Next steps are to identify the appropriate resourcing and funding to drive the desired outcomes. We are requesting the review panel to support this next phase.

The impact of this initiative must be measured carefully. With this campaign, Maths Unlimited! hopes to achieve the following outcomes:

- Reverse the 20-year decline in the proportion of high school students in year 12 studying advanced or intermediate mathematics subjects, over the next 5 years
- Increase the proportion of year 12 students taking any mathematics subject over the next 5 years
- Increase Australian society's appreciation of the importance of mathematics and the need for mathematical education

### Main submission

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

This submission is focused on what capabilities, skills and knowledge students should learn, and in particular, the crucial importance of raising the mathematical skills of current and future generations of Australia's school leavers.

Australia has experienced a 20-year decline in the proportion of school students in Year 12 studying advanced or intermediate mathematics subjects (from 41% in 1996 to 29% in 2015), [AMSI Discipline Profile of the Mathematical Sciences 2016, page 12].

The proposal described in this submission rests upon a core belief that increased demand from parents, teachers and students for mathematics education is critical to arrest the 20-year decline in year 12 students studying intermediate and advanced mathematics.

Through extensive industry consultation in 2015, the Australian Mathematical Sciences Institute (AMSI) confirmed there is a large, growing and deeply concerning gap between the demand and supply of industry-prepared, work-capable graduates with skills in:

- Logical and critical thinking
- Practical ability in problem structuring and solving
- Data analysis and quantitative skills
- Coding
- Working collaboratively, in multi-disciplinary teams
- Communication skills

These skills will be critical for employees of the future. According to the COAG Education Council, "Mathematical thinking is a fundamental skill that underpins all

STEM learning. The sequential nature of mathematical learning means that students who fall off the ‘maths pathway’ early can struggle to achieve sufficient levels of mathematical literacy.” [COAG Education Council, National STEM School Education Strategy, 2015 page 8].

A key finding of a 2012 report to President Obama [Report to The President, Engage to Excel: Producing One Million Additional College Graduates with Degrees in Science, Technology, Engineering, and Mathematics, 2012, Executive Office of the President of the United States] is that mathematics education is a critical component of all undergraduate STEM degrees, and that current deficiencies in mathematics learning are partly driving the loss of STEM majors in the early college years. Further it states “employers in the private sector, government, and military frequently cite that they cannot find enough employees with needed levels of mathematics skills”.

In order to address this skills shortage, a national task force was established in mid 2016.

This task force was a collaboration of senior executives from industry (Commonwealth Bank, Woodside Energy, PayPal, Bain & Company, Google, IBM and BHP) and members from leading university mathematical sciences departments (the Universities of Adelaide, Melbourne, Sydney and NSW, Queensland University of Technology, Monash and RMIT universities).

The task force was established to brainstorm and develop a plan for effectively addressing industry’s needs for a more mathematically qualified work-force, with the necessary critical thinking and problem-solving skills, and to prepare future generations of students with the skills that they will need for the jobs of the future.

Over the course of a year the task force accomplished three key outcomes:

- 1) It successfully piloted a work integrated learning (WIL) program in industry for university mathematical science students. Students reported that this program assisted them to understand that mathematics could lead to a greater range of careers than they were previously aware.
- 2) It designed a high-level strategy for a national awareness campaign to drive increased mathematics participation by high school students through changing society’s perceptions of mathematics. The task force participants believe that in the face of declining demand and interest in mathematics education it is necessary to create demand for mathematics education within the whole community.
- 3) It recognised that deeper engagement is needed with the education sector regarding industry’s skills requirements for graduates and the opportunities available.

The WIL program is continuing as an expanded pilot program in the 2017/2018 summer, and circa 20 university mathematical sciences students from 10 universities in 5 states will take on a placement in Industry. It is planned that this program will expand significantly in future years to encompass a wide range of industry participants, with the medium-term objective of placing at least 100 students annually. It is envisioned that a successful scale-up of the WIL program will create more demand for students from Industry and interest from students in Mathematics. To support this growth for the long-term, a pipeline of students will be required and the health of that pipeline will need attention. In this context, we believe that the proposed national awareness campaign is absolutely essential in order to increase the supply of well-prepared high school graduates with the necessary mathematical skills required for success in the tertiary study of mathematics or STEM disciplines.

It is our intention to engage with the very successful, and Commonwealth government supported, Work Integrated Learning project of the Australian Council of Deans of Science, to understand the key learnings from that program. Our objectives include making these placements available for university course credit and working together with our industry partners to bring the key practical learnings from the placements with industry into the classroom in order to make them widely accessible to mathematical sciences students within their degree programs. Our program supplements the ACDS WIL project by bringing special, additional focus on mathematical skills and also national coordination.

The task force recognises that mathematics underpins all the STEM disciplines, and that all such disciplines will benefit substantially from an increase in the proportion of high school students who are taking intermediate and/or advanced mathematics in Year 12. The task force is committed to exploring ways to execute the national awareness campaign and following wide consultation has determined that to maximise the impact of this campaign it is necessary to reposition this initiative to be able to draw on a broader base of support across all STEM disciplines, not just mathematical sciences.

The task force is currently exploring alternate overarching bodies with which to work, and will reposition with a broader membership, and a new name, as “Maths Unlimited! A collaboration between Mathematics and Industry”.

To this end, Maths Unlimited! is in the process of engaging with a range of stakeholders across the national STEM space, including:

- A cross-section of senior representatives from industry and relevant industry peak bodies, such as Australian Industry Group and FinTech Australia
- Senior representatives from the tertiary STEM disciplines and selected discipline peak bodies, such as AMSI, Science and Technology Australia (STA) and the Australian Academy of Technology and Engineering (ATSE)

- Commonwealth and State governments, including their Chief Scientists and Education Departments, and the COAG Education Council's STEM Partnerships Forum (SPF), chaired by the Chief Scientist
- Other relevant stakeholders, including the Australian Association of Mathematics Teachers (AAMT) and its members, the state associations of mathematics teachers

#### National Awareness Campaign

Maths Unlimited!'s core beliefs and driving principles are:

- A radical improvement in participation in mathematics is key to a prosperous Australia
- Mathematics is an enabler of innovation and underpins all STEM disciplines
- We seek to equip current and future students with the mathematics skills needed for success in the 21st century workplace and to drive innovation

These core beliefs and driving principles were strongly reinforced in a panel discussion on "AI and Future of Work" at the October 2017 Institute of International Finance Annual Membership Meeting in Washington DC. Further, these principles are also endorsed by the Board of FinTech Australia.

Maths Unlimited! plans to address the shortage of suitably qualified graduates with the combination of quantitative and critical thinking skills, together with 'soft' skills, that meet the needs of industry.

As mentioned previously, Australia has experienced a 20-year decline in the proportion of school students in Year 12 studying advanced or intermediate mathematics subjects (from 41% in 1996 to 29% in 2015), [AMSI Discipline Profile of the Mathematical Sciences 2016, page 12]. This decline must be urgently addressed to meet the rapid growth in demand from industry for employees with the critical thinking, problem-solving and quantitative skills, required to underpin Australia's economic prosperity.

Students face a long corridor of choices through their school years, which too frequently close doors to STEM skills and career opportunities. This is a complex problem which requires joint problem-solving and action by all participants, and will particularly require greater interaction and joint effort between the education sector and industry. Accordingly we attach high priority to working very closely and collaboratively with the Commonwealth and State governments, including their Chief Scientists and Education Departments.

Maths Unlimited!'s members have concluded that:

- All segments of Australian society-at-large are largely ignorant about the real value that mathematics provides, and have low awareness of what is possible with a mathematics-enabled education
- A national awareness campaign is required to shift societal perceptions, and to raise awareness among parents, students, teachers, careers advisors and others, that mathematics is an enabler of opportunity, and the fuel for the engine of many industries

Such an awareness campaign will

- Increase societal awareness of the opportunities and benefits that the study of mathematics provides
- Impact the opinions of the key influencers of students, namely, their parents, teachers, careers advisors and peers
- Encourage students to maximise their participation and skill levels in mathematics, to increase their chances for future success
- Positively influence student subject choices through the senior years of high school, thus underpinning other STEM initiatives in schools, and beyond
- Motivate people to become leaders in innovation

Maths Unlimited! has developed a creative brief, and strategy, for the awareness campaign. Next steps are to identify the appropriate resourcing and funding to bring these programs to life to achieve these objectives.

In a similar manner to the very well-known and successful campaigns “Life. Be In It” and “Slip, Slop, Slap”, the objective of the proposed awareness campaign is to influence the general perceptions and behaviours (in this case, with regard to the value of mathematics) of the whole of society. In order to be successful, such campaigns cannot be short-lived and potentially need reinforcing for a generation, or more, until they are fully established as the “norm”.

It is our vision that the key messages from this campaign should reach every student, every parent, every teacher, every company, every school and all members of Australian society, with appropriate and effective tailoring of the messages to all segments. We believe that government endorsement and support will be crucial in order to fulfil this vision.

The Maths Unlimited! members have already committed more than \$0.5M in in-kind support to get to this stage. A full-scale national awareness campaign of this ambitious scope will require approximately \$5M to be spent annually on advertising across widely accessible media, and support material and infrastructure, for the next 3-5+ years. Our proposal is to fund this campaign, and Maths Unlimited!'s other

activities, from a mix of philanthropic, industry and government contributions. A significant commitment from the Commonwealth Government would enable substantial leverage and help turn Maths Unlimited!'s vision into a reality, resulting in very significant benefit for current and future generations of Australian students.

- How should school quality and educational success be measured?

Maths Unlimited! believes that it is very important that the impact of our initiative is measured carefully against the following objectives over at least a 5-year time frame:

- Reverse the 20-year decline in the proportion of high school students in year 12 studying advanced or intermediate mathematics subjects, over the next 5 years
- Increase the proportion of year 12 students taking any mathematics subject over the next 5 years, from the current level of 81%
- Increase Australian society's appreciation of the importance of mathematics and statistics and the need for mathematical education

As a result, Maths Unlimited! has established these as the proposed objectives against which the success of the national awareness campaign should be measured. Furthermore, if applicable, these impact measures may be supplemented by further measures in order to ensure appropriate alignment with any relevant impact measures that are being developed and tracked by the COAG Education Council's STEM Partnerships Forum.

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

Sustained improvement in student outcomes over time is essential to Australia's success over the long term. Such improvement can be driven, in part, by improving the quality of school mathematics teaching. While acknowledging that this is difficult, Maths Unlimited! strongly advocates the need for such improvement and for the provision of appropriate support for mathematics teachers, including high-quality Professional Development, at scale. Maths Unlimited! is not the right body to deliver this Professional Development, but we have strong interest in this outcome. Amongst our members we also have experience through institutional programs and involvement in the Digital Technologies Professional Learning Program, supported by Google, Digital Careers, and the Commonwealth Government through the Department of Education and Training.

Are there barriers to implementing these improvements?

Maths Unlimited! has identified multiple barriers to students taking more, and harder, mathematics subjects. Two key barriers are:

- The perception that students will get a higher Australian Tertiary Admission Rank (ATAR) if they choose other “easier” subjects
- The perception that studying mathematics does not lead to jobs

Our national awareness campaign has been designed to specifically address the identified key barriers. The first of the barriers mentioned here operates by putting the focus of students, parents and school administrators on getting high grades, rather than developing important skills. This impacts not only on the number of students taking intermediate and/or advanced mathematics subjects at Year 12, but also on the numbers taking the other STEM subjects which have somewhat similar perceptions.