Senior Secondary Pathways Review

AMSI Submission
December 5, 2019

The Australian Mathematical Sciences Institute (AMSI) welcomes this review and the opportunity to make a submission. AMSI is a lead advocate for mathematics and mathematics education in Australia across the pipeline, from schools to higher education and research. Its mission is to champion the mathematical sciences for Australia's advancement by (inter alia):

- 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.

For an overview of AMSI's activities to support and enhance the teaching of mathematics in primary and secondary schools, we refer to https://schools.amsi.org.au/.

What are the essential skills, knowledge and capabilities students should expect to leave senior secondary schooling with to help them succeed in their post-school lives?

Good numeracy skills and mathematical understanding are vital to fully and successfully participate in today's society, supporting anything from financial literacy to making informed health decisions and assessing risks. In addition, mathematics and statistics are core to the many jobs and professions that require quantitative skills. More and more professions require an advanced level of mathematical skill and knowledge. To cope with current and future workforce needs, mathematical understanding must be widespread and current gender barriers broken down. Besides mathematical knowledge and methods, mathematical education teaches rational thinking, reasoning, critical analysis, planning, pattern recognition and problem-solving. The grit and persistence required to engage with more difficult mathematics problems promote motivation and positive attitudes. For these reasons, AMSI is in favour of encouraging students to take up mathematics in high school to the highest level they are personally capable of, so they can take the resulting knowledge, skills and attitudes into their post-school pathways, be it vocational education, work or university.

The number of students completing Year 12 has been steadily increasing, as has the number of students pursuing a university degree afterwards. However, participation in senior secondary school mathematics does not reflect this change in academic aspirations. Between 2008 and 2017, the number of domestic students starting tertiary education in a STEM degree grew by nearly 50%, from 48,079 in 2008 to 71,703 in 2017. Many degrees in other areas such as management and commerce and health sciences also have quantitative components, and annual new enrolments in these degrees increased by 47% in the same period. This substantial increase has not been accompanied by a similarly increased take up in Year 12 of the mathematical subjects at level C (intermediate) and D (higher) intended to prepare students for university study in these degrees. Altogether, only 28.9% (66,866) of the Year 12 population studied mathematics to at least level C in 2017, compared to 31.2% (63, 077) in 2008. If the relative Year 12 maths participation had remained steady at 2008 levels, more than 5,000 additional Year 12 students in 2017 alone would potentially have studied mathematics until at least intermediate level and taken that knowledge with them into post-

secondary education (https://amsi.org.au/?publications=year-12-mathematics-participation-in-australia-2008-2017).

There are a number of likely reasons why the engagement with mathematics beyond elementary levels A and B is not keeping up with the growth in Year 12 students or the number of school leavers going to university. They can include a lack of confidence in one's own abilities, the way mathematics is taught at school, perceptions on the need to take mathematics to get into university, and the shortage of teachers with specific pedagogical and mathematical expertise. This shortage is particularly salient in rural and remote schools and schools in socio-economically disadvantaged areas. Given the expected increase in secondary school students in the future, and the ageing of the current mathematical teaching workforce, growing the number of qualified teachers and upskilling teachers who are currently teaching mathematics "out-of-field" must be an urgent priority. Secondly, to reverse the flatlining uptake of mathematical subjects beyond elementary mathematics secondary school students must be given the right incentives and guidance about appropriate subject choices.

How can we help students make better decisions about learning pathways within school?

Students, and those people advising and supporting their decisions including parents, teachers, careers professionals and friends need better information about the possible pathways students might take. This information should include TAFE, VET and trade pathways and university courses taking into account both the required knowledge as well as the pre-requisites. Students also need to see where the skills and knowledge they will develop in their study lead to, what kinds of jobs are possible and what problems can be solved by being more mathematically capable. Evidence shows that resources such as MathsAd(d)s and careers campaigns like ChooseMATHS can help greatly, but they need continued support.

How do we change negative perceptions of certain pathways?

See above. With information provided to students, parents and teachers we can reverse the perception. Also needed is a call by government, industry and business saying that these skills are valued and needed in the workplace. A continued focus on improving the gender balance should remain a priority. Not only do girls need to believe that they belong in and are capable of being successful in STEM-related disciplines, it needs to be seen (particularly by their parents and caregivers) as a sustainable environment for women.

How can we support young people to make better decisions about their post-school pathways?

Many universities do not require a minimum level of mathematics to access their degrees in science, commerce, or engineering. Besides an absence of clear prerequisites at many universities, the

information provision about entry requirements into university degrees and subjects differs by State and Territory. While prerequisite knowledge is often stated on university webpages, other incentive schemes such as bonus schemes may not always be easily accessible. Overall, between states the access to and content of the information about what mathematics is needed is inconsistent and confusing. This lack of clear information and absence of prerequisites feeds into subject choice in secondary school.

Universities should therefore provide clear and timely information to secondary schools, students, career counselors and parents on what level of mathematics background is necessary in each of their degrees and subjects so that students can take this into account to facilitate good subject choices in Year 11 and 12.

In addition, it is desirable for universities to provide incentives to secondary school students to participate in intermediate (level C) or - where this is appropriate, depending on the discipline - higher mathematics (level D) subjects, be it through clearly stated degree or subject prerequisites, bonus or ATAR adjustment schemes, or other means.

How can we make sure opportunities are available and support is tailored to the needs of all young people?

If universities are admitting students who do not have the necessary prior mathematics knowledge for subjects or degrees, they need to provide realistic and achievable pathways for students to gain the prior knowledge needed for successful participation in those subjects or degrees.