Forum on assumed knowledge in maths

Deborah King* and Joann Cattlin*

Time to change the maths message: what does 'assumed knowledge' really mean for students?

Many universities in Australia no longer have prerequisite mathematics subjects for entry to degrees in science, mathematics, engineering and technology, opting for an 'assumed knowledge' entry requirement. There is growing concern in universities across the country that students entering science, engineering and technology degrees do not have the required mathematical background. In response, most universities now offer to commencing students, a variety of mathematics subjects at various levels, a range of support programs or have reviewed their teaching approaches and curriculum to accommodate the diversity of student backgrounds. The impact on universities is significant in terms of the cost of extra service provision, but is most commonly felt by frontline academic staff struggling to teach large classes of first-year students who don't have the required assumed knowledge. While these academics are making significant efforts to adapt their teaching, course content and program structure to improve student outcomes, these efforts do not make up for the deficit in mathematical knowledge. The consequences for students are not only high failure rates in their first-year subjects, but difficulty in applying mathematical skills throughout their science and engineering degree.

These issues were the focus of a National Forum on 'Assumed knowledge in maths: its broad impact on tertiary STEM programs', held on 13 and 14 February at the University of Sydney. The forum was attended by 145 academics and education specialists from mathematics, science and engineering from universities across Australia and New Zealand, along with representatives of state curriculum authorities, the Australian Association of Mathematics Teachers, the Catholic Education Office and peak science and mathematics bodies like the Australian Mathematical Sciences Institute (AMSI) and the Australian Mathematical Society (AustMS). The forum was organised by the First Year in Maths (FYiMaths) project (funded by the Office of Learning and Teaching) and supported by the Institute of Innovation in Science and Mathematics Education (IISME) at the University of Sydney.[1]

*Department of Mathematics and Statistics, The University of Melbourne, VIC 3010.
Email: dmking@unimelb.edu.au, joann.cattlin@unimelb.edu.au

[1]The FYiMaths project is investigating the challenges facing first-year mathematics coordinators and has recently interviewed academics at universities across the country. IISME hosted the forum as part of its activities in encouraging engagement in the scholarship of teaching and learning in science and mathematics.

The Chief Scientist, Professor Ian Chubb gave the opening keynote address in which he expressed concern that while the numbers of students studying high-level maths at high school were falling, there continues to be growth in students enrolling in STEM degrees. He identified a range of issues that had led to the decline in students' studying higher level maths, including a lack of incentive due to the removal of prerequisites for mathematics by universities and resulting perception that even intermediate level maths wasn't necessary to study STEM. He characterised the forum as a significant community of interest who could influence policy through working with the secondary sector to enhance understanding of the importance of mathematics for studying STEM and to provide support to teachers through specialist professional development.

A key element of the forum was the collection of presentations by academics on their institutions' approaches to teaching mathematics to diverse student cohorts and the adaptive responses developed through program and curriculum reviews. Most of the presentations are available on the FYiMaths project website (visit www.fyimaths.org.au).

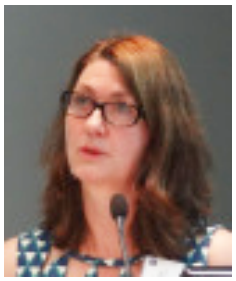
The presentations revealed that institutions are developing a range of teaching approaches that scaffold learning through tasks and assessments that focus on developing key mathematical skills, building student's confidence and self-awareness. Different class formats have also been trialled, including smaller seminar-style classes, 'flipped classrooms' and variations of lecture recording.

One of the key tools used by many institutions is diagnostic testing of mathematical skills for incoming first-year students. Tests can be administered before, or early in, the first semester of first year, they may be compulsory or voluntary, and may direct student enrolment in specific courses, or serve as formative assessment. A number of institutions have developed their own test, while others have adapted those used at other institutions.

Bridging programs are a common mechanism to enable students without mathematics from school to develop the required mathematical skills for STEM programs. There are two main models of bridging program: a pre-semester short course that is fee based and open to the public, and a semester course that is credited as part of a degree program. The presenters reported mixed results from their bridging programs, with concerns expressed about the depth of knowledge developed, and the problems of teaching mathematics alongside other first-year STEM subjects requiring this knowledge.

A key element of course and degree program redesign at many institutions was the collaboration that happened between the staff teaching mathematics and their colleagues in science and engineering disciplines. On a practical level consultation enabled mathematicians to identify the key mathematical skills their students need for science and engineering and to contextualise examples of maths applications. Most importantly consultations established an understanding and ongoing consultative relationship that further enhanced the integration of mathematics subjects into the degree programs, increasing student engagement and linking the maths they learnt in first year to later courses in their degree.

The outcome of the forum has been to develop a consensus amongst STEM academics, peak mathematics bodies and education specialists on the need to work together to arrest the declining maths skills of students. In the coming months the FYiMaths project will initiate actions intended to promote further discussion about how to redress the concerns about how the removal of prerequisites is influencing student choices.



Dr Deborah King is the Director of First Year in the Department of Mathematics and Statistics at the University of Melbourne, and is the project leader of First Year in Maths. She is also involved in a number of teaching and learning projects, including assessment practices, communication skills, and mathematical misconceptions. She has been involved in curriculum design at both tertiary and secondary level.

Joann Cattlin is the project manager of the First Year in Maths project. She has been a project officer and researcher on ALTC and ARC projects utilizing her background as a university librarian and experience in government policy work. She is currently completing a Master of Information Management and her research interests include communities of practice and information seeking behaviours.