The Australian Curriculum for Mathematics

Michael Evans*

A discussion of the writing and implementation of an Australian curriculum has been taking place over the past two decades. In the following, a brief summary of the pathway to the formation of the drafts for K–12 curriculum in mathematics is given and the structure of the mathematics courses is outlined. The information presented here has been derived from press releases from the Australian Curriculum, Assessment and Reporting Authority (ACARA) and from their web site[1].

In April 2008 the inaugural meeting of the interim National Curriculum Board was held in Canberra. Professor Barry McGaw AO was appointed as the Chairman of this board. Consultation began in June of that year with key stakeholders. At this inaugural meeting the then Deputy Prime Minister, Julia Gillard, reinforced the importance of the collaborative process being undertaken, and the essential role that Australian and international evidence will play in creating a national curriculum which underpins world-class education outcomes. 'We have a rare opportunity here to create a curriculum which helps achieve educational excellence across the whole community and it should be shaped by the best material and experience there is,' Ms Gillard said.

The ACARA board was announced in May 2009 with Professor Barry McGaw AO as Chairman. ACARA is responsible for:

- a national curriculum from Kindergarten to Year 12 in specified learning areas,
- a national assessment program aligned to the national curriculum that measures students' progress,
- a national data collection and reporting program that supports analysis, evaluation, research and resource allocation and accountability and reporting on schools and broader national achievement.

Why have an Australian Curriculum?

In 2008, all Australian governments agreed that a quality education for all young Australians is critical to maintaining Australia's productivity and quality of life. They agreed that a national curriculum would play a key role in delivering quality education, and committed to the development of a K–12 national curriculum, initially in the areas of English, mathematics, science and history.

*Australian Mathematical Sciences Institute, 111 Barry Street, c/- The University of Melbourne, VIC 3010. E-mail:michael@amsi.org.au

[1]The ACARA website: http://www.acara.edu.au.

Subsequently, all Australian education ministers committed to a set of educational goals and actions to better prepare young people for participation in a changing and increasingly globalised world. One of these actions was the development and implementation of a national curriculum.

It is widely accepted that Australia should have one curriculum for school students, rather than the eight different arrangements that exist at the moment. The commitment to develop an Australian Curriculum means that:

- the individual and combined efforts of states and territories can focus on how students' learning can be improved to achieve the national goals, regardless of individual circumstances or school location;
- greater attention can be devoted to equipping young Australians with those skills, knowledge and capabilities necessary to enable them to effectively engage with and prosper in society, compete in a globalised world and thrive in the information-rich workplaces of the future;
- high-quality resources can be developed more efficiently and made available around the country;
- there will be greater consistency for the country's increasingly mobile student and teacher population;
- what young people should be taught and the quality of learning that is expected of them will be made clear in the Australian Curriculum. At the same time, it will provide flexibility for teachers and schools to build on student learning and interest.

Whilst the Australian Curriculum will outline the scope of what is to be learned, it will be teachers in classrooms who will make decisions about how best to organise learning, the contexts for learning and the depth of learning that will be pursued for each child in their class.

The national curriculum for mathematics

The writing of the draft K–10 Australian curriculum for mathematics began in May 2009 and appeared on their website for consultation in February 2010. This consultation process concluded at the end of May 2010. The writing of the draft Years 11 and 12 curriculum began in August 2009 and is now on the ACARA website. It is possible to comment on this draft until the end of July. Senior secondary curriculum achievement standards will be developed through 2010.

The K–10 mathematics curriculum

The three content strands in the Australian K-10 curriculum will be as follows.

Number and algebra. In this content strand the concentration in the early years will be on number, and, near the end of the compulsory years, on algebra. An algebraic perspective can enrich the teaching of number in the middle and later primary years, and the integration of number and algebra, especially representations of relationships, can give more meaning to the study of algebra in the secondary

years. This combination incorporates pattern and structure and includes functions, sets and logic.

Measurement and geometry. While there are some aspects of geometry that have limited connection to measurement, and vice versa, there are also topics in both for which there is substantial overlap, including newer topics such as networks. In many curricula the term 'space' is used to cover mathematical concepts of shape and location. Yet many aspects of location, for example maps, scales and bearings, are aligned with measurement. The term 'geometry' is more descriptive for the study of properties of shapes, and also gives prominence to logical definitions and justification.

Statistics and probability. Although teachers are familiar with the terms 'data' and 'chance', the terms 'statistics' and 'probability' more adequately describe the nature of the learning goals and types of student activity. For example, it is not enough to construct or summarise data — it is important to represent, interpret and analyse it. Likewise, 'probability' communicates that this study is more than the chance that something will happen. The terms provide for the continuity of content to the end of the secondary years and acknowledge the increasing importance and emphasis of these areas at all levels of study.

Proficiency strands

The four proficiency strands in the Australian mathematics curriculum will be as follows.

Understanding, which includes building robust knowledge of adaptable and transferable mathematical concepts, the making of connections between related concepts, the confidence to use the familiar to develop new ideas, and the 'why' as well as the 'how' of mathematics.

Fluency, which includes skill in choosing appropriate procedures, carrying out procedures flexibly, accurately, efficiently and appropriately, and recalling factual knowledge and concepts readily.

Problem solving, which includes the ability to make choices, interpret, formulate, model and investigate problem situations, and communicate solutions effectively.

Reasoning, which includes the capacity for logical thought and actions, such as analysing, proving, evaluating, explaining, inferring, justifying, and generalising.

The development of the Australian mathematics curriculum offers a wonderful opportunity to revitalise the experience of all mathematics learners in a way that respects equity considerations. A key first step is to affirm a commitment to ensuring that all students experience the full mathematics curriculum until the end of Year 10, and with schools developing relevant options preserving, for all students, the possibility of further mathematics study. This signals to systems and schools the requirement to ensure structures are inclusive, and that support is available for students who need it.

One aspect of making the mathematics curriculum accessible is to emphasise the relevance of the content to students. Any mathematical concept or skill can be introduced by drawing on practical situations and so the purpose of the study is more obvious, and the mathematics is made more meaningful.

The curriculum must also provide access to future mathematics study. It is essential, for example, that all students have the opportunity to study algebra and geometry. The US National Mathematics Advisory Panel (2008)[2] argues that participation in algebra is connected to finishing high school; failing to graduate from high school is associated with under-participation in the workforce and high dependence on welfare. The study of algebra clearly lays the foundations not only for specialised mathematics study but also for vocational aspects of numeracy. Yet the study of algebra represents a challenge for many students during the compulsory years, and serves to exclude some students from further options.

There is now an opportunity to rethink the curriculum in the early secondary years. The intention is to increase student access to relevant and important mathematics, with a particular focus on ensuring that algebra and geometry are developed in meaningful and interesting ways.

The senior secondary mathematics courses

There are four courses for Years 11 and 12 mathematics. Each course has been divided into four units, typically for completion over four semesters. The courses are differentiated, each focusing on a pathway that will meet the needs of a particular group of senior secondary students. The names of the courses at present are:

Course A (Essential Mathematics)
Course B (General Mathematics)
Course C (Mathematical Methods)
Course D (Specialist Mathematics)

Course A (Essential Mathematics) has been designed as a standalone subject. However consideration has been given to those students who may wish to pick up a mathematics course at unit 3, having previously not studied mathematics in the senior years, or who have studied units 1 and 2 of Course B.

Course A focuses on using mathematics to make sense of the world. The emphasis is on providing students with the mathematical knowledge, skills and understanding to solve problems and to undertake investigations in a range of workplace, personal, training and community settings. There is an emphasis on the use and application of information and communication technologies in the course. The topics in this course include measurement, financial mathematics and statistics.

Course B (General Mathematics) has been designed to stand alone or to be studied in conjunction with Course C (Mathematical Methods). Students may choose to move from Course B to Course A at the end of units 1 or 2.

[2]See http://www2.ed.gov/about/bdscomm/list/mathpanel/report/final-report.pdf.

General Mathematics aims to equip students with the confidence, understanding, skills and strategies to apply mathematical and statistical techniques to the analysis and solution of problems. The course provides an introduction to some areas of statistics and discrete mathematics, including financial mathematics. General Mathematics is designed for students who wish to undertake further studies in areas such as agricultural science, the health sciences, biology, psychology, sociology, political science, business studies and education. In all of these areas, mathematical and statistical knowledge can facilitate understanding, problem solving and decision-making.

Course C (Mathematical Methods) has been designed as a standalone course or to be taken in conjunction with General Mathematics (Course B) or Specialist Mathematics (Course D).

Mathematical Methods is designed for students with an interest in mathematics and whose future pathways may involve mathematics and statistics at university. The focus is on calculus, probability and statistics. The course provides a foundation for further studies in disciplines in which mathematics and statistics have important roles, including economics, primary teaching, secondary mathematics and science teaching, and all branches of engineering, physical and biological sciences.

Course D (Specialist Mathematics) is designed to be taken in conjunction with Course C. Consideration has been given to allow students who have studied units 1 and 2 of Course C to enter Course D at unit 3.

The course contains topics in functions and calculus that build on and deepen the ideas presented in Course C. Vectors, complex numbers and iterative methods are introduced. A topic selected from among three options (statistical inference, vectors and dynamics, further calculus techniques and inequalities) contributes further depth in the chosen area. Course D is designed for students with a strong interest in mathematics including those intending to study mathematics, physical sciences, or engineering at university.

Dr Michael Evans is responsible for the ICE-EM mathematics program. He has a PhD in mathematics from Monash University and a Diploma of Education from La Trobe University. Before coming to ICE-EM, he was Head of Mathematics at Scotch College, Melbourne, and was involved with the Victorian Curriculum and Assessment Authority in various capacities. He has also taught in public schools. In 1999 he was awarded an honorary Doctor of Laws by Monash University for his contribution to mathematics education, and in 2001 he received the Bernhard Neumann Award for contributions to mathematics enrichment in Australia.