AAMT Response to the Draft Senior Secondary *Australian Curriculum: Mathematics*

July 2010

Presented by

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EXECUTIVE SUMMARY

The Council and Executive of the Association of the Australian Association of Mathematics Teachers (AAMT) welcomes the opportunity to respond to the *Draft Senior Secondary Australian Curriculum: Mathematics*. This paper draws on comments and feedback from a wide range of members and others involved in school mathematics.

The full paper contains analysis and recommendations on many aspects of the draft. The following is a summary of the key points.

- The design of the curriculum needs to be examined to maximize flexibility, accessibility and uptake of mathematics in the senior years.
- There is too much content in each of the courses.
- Courses A and B are too difficult for the targeted cohort.
- The use of technology must be made explicit and its role in assessment addressed.
- The Rationale and Aims for each course need further development.
- The Proficiencies and the General Capabilities need to be more prominent.
- The pathways for the study of senior secondary mathematics and post school choices are not clear.
- Articulation with K-10 needs to be examined more closely.

The AAMT looks forward to continuing to work constructively with the officers of ACARA in the interests of mathematics in Australia's schools.

BACKGROUND

The mathematics curricula that are currently in place around the country are different in many ways including arrangement, layout, level of detail, and responses to key issues in the teaching and learning of mathematics. State and territory perspectives are at times contradictory, given that they are based on the heritage and background of the respondent.

The construction of national feedback from the AAMT is a challenging task. We do not try to weigh these views to come to an "AAMT stance" on matters of detail. Rather, our focus is on highlighting and discussing common concerns and, where practical, recommending ways to improve the Draft.

STRUCTURE

COURSES

Considerable concern was expressed that Course A, as the "foundation" mathematical subject, was too difficult. This difficulty is especially true for those students with learning difficulties, from non-English speaking backgrounds, and those with inadequately developed mathematical skills through their experiences in K-10. It is acknowledged that "to set the same high expectations for all students and to provide differentiated levels of support to ensure that all students have a fair chance to achieve those expectations" (*Shape of the Australian Curriculum*) is an admirable and important goal, and one which is supported by the AAMT. However, it must also be acknowledged that it is unproductive for those students who are unprepared for the demands of a particular regime of study to be placed where they will fail. There is a need for a course that is less demanding than Course A to provide functional numeracy, "completion" for many students who are not catered for in the current set of courses.

Course B (and, for some respondents, Course C as well) was also considered too ambitious for the intended candidature. Some were concerned that this perceived difficulty would drive students to select Course A as a default rather than for its applicability to their needs. It was suggested that parts of Courses A and B could be combined to produce a course which more closely mirrored current offerings that have a "general" or "applications" character. This hybrid would appeal to students intending future pathways in trades, business, and TAFE study as well as some University courses.

Respondents had very clear notions of the needs and mathematical backgrounds of their students, and therefore were very firm in their recommendations. Although the mathematical backgrounds of students might be expected to change somewhat over the years with the effective implementation of the K-10 curriculum, the range of courses needed to accommodate them would quite likely remain the same. Thus the overall structure to meet the needs of students would be a course "below" A, one that sits between A and B, then B, then C, then D. The table below indicates five possible courses, each with a distinct future pathway. They have been matched in a very broad way to the courses outlined in the Draft, and the proportions of the cohort that might be expected to select each course has been estimated.

COURSE	<A	A/B	B	C	D
COHORT	General numeracy	TAFE, University (other)	TAFE, University (as per current Course B)	Quantitative Sciences	Engineering
ESTIMATED PROPORTION	20%	25%	30%	20%	5%

The majority of students would be expected to select from the first three courses.

As each course has a distinctly different pathway, the content should also have a distinctly different flavour.

The AAMT recommends that a course for General Numeracy be included to cater for those students who might otherwise be excluded from further study of mathematics.

The AAMT recommends that the suite of courses are sufficiently different and be better matched to adequately cater for the different ambitions and backgrounds of students.

PATHWAYS AND FLEXIBILITY

There were concerns that there were many implications arising from the 10/10A structure. It is anticipated that many students would study the core Year 10 course only, and not take up 10A. The decision to take up 10A needs to occur at the end of Year 9 which is too early for many. Students may not have developed sufficiently mathematically to see 10A as a viable course for them, they may not yet have any firm ideas about possible career directions or they simply may be too young to sensibly consider the implications of the choices made at this stage. Since content from 10A is identified as prerequisite for aspects of Courses C and D, students who do not do 10A could only realistically choose from Courses A or B in Year 11. To create a structure and prerequisites that could be interpreted by schools in a way that precludes a large number of students from the opportunity to participate in Courses C and D is not acceptable.

The flexibility of changing courses either at the end of Unit 1 or Unit 2 was regarded as a sensible way of allowing students to select and succeed with a mathematics course which best suits their needs, interests and abilities. For these transitions to occur smoothly it is essential that there is clear articulation between the units of the different courses so that students are not disadvantaged. In particular, movement from B to A and C to B after one or two units needs to be integrated with respect to content and sequencing. A diagram showing the various pathways moving from 10 and 10A through to Year 11 and then Year 12 would be more accessible than referring to the organization section of each of the courses.

Some questioned the wisdom of allowing the selection of Course D in Year 12 without having studied it in Year 11. Similar concern was expressed for students choosing Course A in Year 12 without having studied any mathematics in Year 11.

In the draft model, students can choose either one full subject (two units) or two full subjects (four units) of mathematics. Respondents have commented on the falling number of students choosing two full subjects and the effect that this will have on the mathematics community and society at large. It is currently possible to do three units of mathematics in some jurisdictions. It has been strongly suggested that the equivalent of three semesters in Year 11 and/or Year 12 be an option. If this option is to be considered, further consultation is needed with the accrediting bodies of the states and territories.

The AAMT recommends that a diagram showing the various pathways moving from 10 and 10A through to Year 11 and then Year 12 be produced. The selection and ordering of content should be analysed and adjusted where necessary to ensure the pathways are achievable. Any precluded combinations of subjects should also be stated.

The AAMT recommends that the principle of flexibility be extended to include the possibility of a structure similar to the current NSW 3 unit option.

RATIONALE AND COHERENCE

RATIONALE AND AIMS

The rationale and aims of each of the four courses should more clearly identify the purpose of each course, the intended candidature and the possible future training and career pathways. A diagram showing future training and career pathways is needed. It is vital that the pathways indicated will indeed be achievable through the study of the particular course shown.

The AAMT recommends that a diagram showing the various pathways for future training and careers should be produced.

Each rationale should be written to engage the interest of students through highlighting the relevance and enjoyment to be gained from studying this particular course of mathematics. In the current Draft the rationale and aims focus on the content to be taught and the courses appear to be rather dry and uninteresting.

The AAMT recommends that the current rationale and aims for each course be developed to highlight the relevance and enjoyment of the mathematics within.

COHERENCE OF RATIONALE AND TOPIC SELECTION

Many respondents commented that the materials in the courses lacked coherence; that the connecting threads and essential mathematical themes were lacking. Each course should have a clear over-arching purpose. The topics chosen should certainly lead students to their chosen endpoint, whether that be further study of mathematics or as a satisfying completion to many years of engagement with mathematics at school, but they should also make sense to the students in a mathematical way. At the senior secondary level it is not only possible but important to introduce to students the rich inter-connectedness between the topics of more advanced mathematics.

The AAMT recommends that the current rationale and aims for each course be further developed to provide coherence and a clear picture of the purposes for the selection of content.

CONTENT AND CONTINUITY

AMOUNT OF CONTENT

There was overwhelming agreement that there is far too much content in each of the courses. Respondents felt very strongly that depth of understanding was being sacrificed for breadth. If students are to address the proficiency strands in a substantial way, particularly those of Problem solving and Reasoning, then sufficient time must be given for exploration and reflection. The implication is that there must be some reduction in the amount of content prescribed.
Respondents gave many suggestions for possible changes: content to be deleted, replacement content and content to be moved to other courses. This detail is in the responses forwarded directly to ACARA.

The AAMT recommends that ACARA carefully consider the changes to content given in the individual submissions.

CONTINUITY WITH K-10 CURRICULUM

Continuity with the K-10 curriculum is difficult to assess when the draft of that document has not been finalized. Working from the draft document, there were a number of examples of lack of continuity given in individual submissions. It is essential to check that the K-10 curriculum does articulate satisfactorily with the Senior Years Curriculum when completed.

There was also considerable interest in whether the draft *Australian Curriculum: Mathematics K-10* is a statement of what all students are expected to learn in the compulsory years. Some suggested that Course A takes as its prerequisites knowledge and understanding well below that of Year 10. This seems contradictory and is unhelpful for schools and teachers.

The AAMT recommends that each topic in each course in the Senior Years is checked to ensure that sufficient preparation has been provided in the K-10 curriculum.

PROFICIENCIES, GENERAL CAPABILITIES and CROSS-CURRICULUM PERSPECTIVES

The proficiency strands should be more clearly articulated within the document. There is a good deal on what content is to be covered but little on how that content is to be explored or developed.

The proficiency strands "provide the language to build in the developmental aspects of the learning of mathematics" (*Draft Senior Secondary Australian Curriculum: Mathematics*). In the K-10 Draft the elaborations assist in showing what type of skills may be employed in the learning process. The use of words such as compare, choose, evaluate, identify, solve, discuss, transform and model reference the proficiencies. Although some descriptors of this type are used in the Senior Draft (most usually in Courses A and B) the topic detail frequently consists of a list of content. It would assist users of this Draft for the content lists to be expanded to include descriptors drawn from the proficiency strands. Understanding and Fluency would be integrated in many core areas, and Problem solving and Reasoning should be emphasized in all courses to develop students' skills as successful learners.

The outlines of the investigations should refer to the proficiencies. The general capabilities should also be highlighted. Depending on the form of the investigation, the general capabilities of literacy, thinking skills, creativity and information and communication technologies, as well as self-management and teamwork could be addressed. The proficiencies of Reasoning and Problem solving will also be addressed in a significant way within this mode of teaching and learning.

The AAMT recommends that redrafting of the curriculum document pay attention to more explicit reference to the proficiencies. A process similar to that used for the redrafting of the K-10 curriculum should be considered.

INVESTIGATIONS

There was strong agreement about the value of investigations. Respondents appreciated the opportunity for students to use their mathematics to model, explore and develop or deepen understandings. As outlined above, investigations also address many of the general capabilities in a profound way. In addition, a suitably targeted investigation could also incorporate cross-curriculum dimensions.

Given the rich possibilities inherent in investigations, they should appear in each of the standalone courses (i.e. A, B and C), with their number varying depending on the amount of time available. Because Course D is designed as a paired course, investigations would be covered in Course C.

There was comment about whether investigations should appear as "Unit Content" as is currently the case in Course A. Most respondents considered investigations as either an assessment type or a pedagogical approach. The argument for keeping investigations under the umbrella of unit content is one of compliance. If listed as content then an investigation must be done; since this type of task is highly valued,

this would certainly be desirable. However, it should be emphasized to teachers that the investigation need not be done as a block, but could be tackled throughout the semester. Advice and support to do this well should be provided to teachers, both within the curriculum document and beyond.

It was appreciated that the Draft suggested investigations have different levels of support over the year, as students became more familiar with this style of learning. However, there was also a perceived need for explicit direction in what would make a good investigation: length, standard, how assessed etc.

The AAMT recommends that investigations be included in Courses A, B and C and that there be specific direction given about the requirements of an investigation.

TECHNOLOGY

The AAMT takes the position that technology can do much more than "aid in developing skills and allay the tedium of repeated calculations" (*Draft Senior Secondary Australian Curriculum: Mathematics*). Through the intelligent use of technology, the "curriculum is characterized by challenging and relevant learning experiences, rigour and suitable emphasis on processes" and the teaching and learning "characterized by approaches that include investigation, individual and collaborative modes of working and an emphasis on developing an understanding of mathematics as richly connected concepts"*(A Communique to the Education Community, Graphics Calculators and School Mathematics).*

The use of technology within the teaching of the content must be made explicit. In many cases there is a significant difference in the teaching required and the learning experienced depending on the extent (if any) of the use of technology. Currently there is potential for much confusion.

The Draft makes the statement that jurisdictional assessment agencies will make the decision about using technology in assessment programs. There is a considerable range of positions within those agencies towards the use of technology in the teaching and learning as well as assessment practices. The AAMT takes the position that it is sound educational practice to assess students with the same tools as they use in their learning *(AAMT Position Paper on The Practice of Assessing Mathematics Learning 2008)*. Hence technology should be used in at least part of the formal assessment of students. The nexus between technology, teaching and learning and assessment means that the role of technology has to be specified across each of these in a consistent way.

The AAMT recommends that the use of technology in the currriculum be made explicit.

The AAMT recommends that ACARA should consult with the jurisdictional assessment agencies to come to a common position on the use of technology in assessment.

NAMES, TIME, IMPLEMENTATION AND TEACHER SUPPORT

NAMES OF COURSES

The names of the courses are not favoured. They are not considered to be informative descriptors and there is overlap with some existing course names which is confusing. Unfortunately there were few suggestions for alternatives. The use of letters to identify courses does not have these connotations (other than in Queensland) but may not mesh well with public perception in that "highest" course has "lowest" letter.

The AAMT recommends that alternative names for each of the courses be explored.

TIME FOR TEACHING MATHEMATICS

The number of hours to be allocated must be clearly specified. Without this information it is difficult to make definitive recommendations about the amount of content. Comment on these matters is based on respondents' current settings and practices. There was concern that it would be very difficult to teach what was required (even with deletions) unless sufficient time was allocated.

The AAMT recommends that the time for teaching mathematics should be nationally set at 60 hours per semester (30 hours per unit) to make the expectations of the Senior Years Curriculum feasible in practice.

IMPLEMENTATION

There were practical issues raised about the implementation of the curriculum in schools.

In the *AAMT Response to the Draft K-10 Australian Curriculum: Mathematics* it was considered that the Year 10 curriculum was too full in terms of content. There is the addition of even more content from 10A as assumed knowledge for entry into Courses C and D. It is unrealistic for both to be studied within the same amount of time in a "normal" year. Some schools may choose to teach both within the usual time with advanced classes, but for other classes, which may well contain students with ambitions to undertake Courses C and D, it will mean that 10A has to be taken as a unit separate from 10. This has obvious timetabling and staffing implications.

There was concern that some schools may not have the resources to offer all four courses.

It was also suggested that some schools may have to teach two courses within the one classroom.

TEACHER SUPPORT

All respondents made comment on the issue of teacher skills. For many, "new" content was welcomed, albeit with some caution. There was a forcibly expressed need that significant professional learning and the development of support materials had to occur for both experienced and novice teachers of mathematics in order to be suitably prepared to teach the Australian Curriculum successfully.

The AAMT recommends that governments and other stakeholders develop and implement a sustained and well-designed program to develop teachers' skills to match their needs in relation to the Draft Senior Secondary Australian Curriculum: Mathematics.