



**AAMT Response to  
*National Mathematics Curriculum: Framing Paper***

March 2009

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# **AAMT Response to National Mathematics Curriculum: Framing Paper**

*A draft response was developed following discussions of the consultation version of the Framing Paper during the January 2009 meeting of the AAMT Council. This draft was made available to members throughout February for their comments. This final response was then developed and is provided to the National Curriculum Board.*

*The AAMT welcomes the opportunity to provide comments on the National Mathematics Curriculum: Framing Paper. We take this opportunity to acknowledge the openness of the processes being used by the NCB and look forward to providing further input to the work on behalf of Australia's teachers of mathematics.*

*The President and Executive of the AAMT commend the views of practising teachers to the NCB. If clarification or further elaboration is required, please contact Mr Will Morony, AAMT Executive Officer (08 83630288; [wmorony@aamt.edu.au](mailto:wmorony@aamt.edu.au)) in the first instance.*

## **1. Introduction**

- 1.1. The AAMT welcomes recognition of the need for a curriculum that is futures-oriented, supports all students to learn mathematics and emphasises deep understanding and 'big ideas', and that is useful for and usable by all teachers of mathematics. However, it must be recognised that successful implementation – so that these intentions do indeed become the reality in all of Australia's classrooms – will be heavily dependent on a concerted and sustained commitment of resources to:
  - Attract and retain well-prepared teachers;
  - Provide for ongoing professional learning for all teachers of mathematics in the face of profound changes in the discipline and substantial development in our knowledge of how mathematics is learnt;
  - Actively and significantly reduce the differential performance of students that is based on factors other than their interest and potential in mathematics (eg city/country, Indigenous/non-Indigenous, high/low socio-economic status);
  - Develop and provide access to high quality teaching and learning resources and technologies; and
  - Ensure there is adequate time in the school week for students to learn the mathematics necessary for them as involved and productive people in the 21<sup>st</sup> century.
- 1.2. The embedding and specific identification of numeracy within the mathematics curriculum is positive in that it supports careful attention to numeracy development through the teaching and learning of mathematics. However, numeracy is a cross-curricular concern and as such requires the engagement of teachers of history, the sciences, English and other discipline areas. The mechanism by which this engagement will occur if numeracy is dealt with as a subset of the mathematics curriculum is not made clear. Further, many instances of numeracy across the curriculum are statistical in nature. Hence there needs to be significant and careful attention to statistical learning in the mathematics curriculum at all levels. This needs to be done in a way that supports students' development of statistical literacy.
- 1.3. There are significant concerns about the timeline for implementation of the National Mathematics Curriculum, particularly in Stage 4. One estimate was that 2013 is the earliest that a Year 12 curriculum can be implemented. It is acknowledged, however, that, whilst the

national Mathematics Curriculum must be ‘implemented’ in all jurisdictions, what that means in practice at the classroom level has yet to be defined.

- 1.4. No mention is made of the intended process for review of this national curriculum in action, nor of a timetable for its renewal. The AAMT believes that revision of this national curriculum needs to be done to a clear timetable, and be based on systematic monitoring of the implementation of this version that begins on day one of its use in schools.

## **2. Aims**

- 2.1. The AAMT endorses the general sentiments expressed in paragraphs 17 to 20, and expects the national curriculum to ensure that the intentions of paragraph 18 become a reality.
- 2.2. AAMT members would like to see explicit articulation amongst the ‘aims’ of the commitment that the school mathematics curriculum should provide ALL students (including learners with particular gifts and talents or difficulties) with the opportunity to succeed and to maximise their mathematical learning.
- 2.3. AAMT welcomes the recognition in paragraph 18 of the value of encouraging students to enjoy mathematics and appreciate its beauty and power. Also important, but not yet mentioned, is the need to encourage development of positive attitudes towards mathematics and mathematical learning.
- 2.4. Paragraph 17 could be strengthened to read “Mathematics is essential and must hold a central place in school curriculums...”

## **3. Terms used in the paper**

- 3.1. The suggested grouping of content is reasonable and logical, and strands are appropriate across the stages of schooling.
- 3.2. Use of the terms “geometry”, “statistics” and “probability” rather than “space”, “data” and “chance” is appropriate for the reasons articulated in the framing paper. There is some concern that “statistics and probability” is less “user-friendly”, especially in the earlier stages of schooling than “chance and data”; the linking of “geometry” and “measurement” was seen as particularly positive by some as it will provide a natural area for making connections in the mathematics. At a pragmatic level, it was suggested that changing the names has the potential to “‘force’ teachers to genuinely take notice of what is contained, rather than assuming the ‘same old’...”
- 3.3. It is important not to downplay the significance of algebra learning in the early years – in the current Framing Paper the discussion of algebra in primary school is restricted to “An algebraic perspective can enrich the teaching of number in the middle and later primary years”. An emphasis on “patterns” is seen as the productive approach. A useful and effective algebraic perspective on arithmetic comes from studying the patterns, extending these and seeking ways to describe them. As one respondent group put it:  
“Pattern making is a natural exploratory activity of young children. As students create patterns, they develop the understanding that mathematical patterns feature some sort of regularity. By giving all students opportunities to create patterns from an early age we will develop their capacity to generalise about number patterns and relationships. This ability is at the heart of algebraic thinking.”
- 3.4. It will be important to make links between algebra and number clear for teachers.
- 3.5. The identified proficiency strands are helpful in fleshing out the notion of ‘working mathematically’ and the terms used are appropriate. Additional considerations might include greater emphasis on communication and collaboration. Also, problem posing could be explicitly included in the description of the problem solving proficiency strand. There has

been an emphasis on ‘working mathematically’ in all jurisdictions over recent years. As a result there are varying views on the topic. Two strategies for building common understandings are to more fully elaborate the proficiency strands and to avoid the use of the term ‘working mathematically’.

- 3.6. The intention to articulate proficiency standards for strands such as problem solving and reasoning is welcomed. Explicitly addressing the challenge of how to assess learning in these areas is essential. In addition, teachers also need advice about the metacognitive processes involved in learning to problem solve etc. – if not in the curriculum document itself, then in accompanying advice to teachers.
- 3.7. It is noteworthy that the framework proposed in the Framing Paper differs from the one used to underpin the PISA program. It may be necessary to link the two frameworks, given the importance of PISA in the National Assessment Program.
- 3.8. The proposed curriculum structure does not explicitly address affective components of mathematical learning. Given the intention to provide proficiency standards, it is not obvious how this might best be achieved (e.g. the challenge of defining expectations for students’ development in perseverance or enjoyment of mathematics) – but the affective domain is an important area and warrants consideration.
- 3.9. Some concern has been expressed about the term ‘proficiency’, largely because this term is often associated with measurement or assessment. On the other hand, the assessment orientation is implied by the anticipated inclusion in the curriculum of expectations for the performance standards (para. 25). This matter will need to be made clear as part of the further development of the national mathematics curriculum.
- 3.10. The location of numeracy primarily within mathematics curriculum documents is problematic and somewhat at odds with Recommendation 1 of the National Numeracy Review Report (that all teachers be prepared as teachers of numeracy). Great care and attention will be required to ensure that the recommended cross-curricular commitment and responsibility for numeracy is meaningfully addressed and supported in the curriculum. Every subject has a role to play, and if a specialist history or sciences teacher is genuinely expected to be addressing numeracy in his or her teaching, then the expectations involved in that should be clearly articulated. How this will be achieved is a challenge for both the writing and the implementation of the new curriculum.
- 3.11. The definition of numeracy provided in paragraph 27 is appropriate. However, as noted in the National Numeracy Review Report from which it is drawn, the term is neither used nor interpreted uniformly across the community. A telling example of this lies in the current national ‘numeracy’ assessment programme, which in fact addresses not numeracy *per se* but rather is focussed on underpinning mathematical knowledge and skills.

#### **4. Considerations**

The AAMT welcomes and endorses the clear consideration and recognition of the issues identified in the framing paper. Some particular emphases and additional comments are included below.

- 4.1. The documents must be user friendly. The intended emphasis on clarity and succinctness is commended, as is the recognition that they must be manageable for, and support the spectrum of, teachers of mathematics in our schools, including early career teachers and teachers with multi-disciplinary responsibilities.
- 4.2. Addressing ‘crowded curriculum’ issues is imperative. The opportunity for students to study key concepts in much greater depth is particularly welcome. One aspect of this will be the clear articulation and emphasis of the ‘big ideas’. Another may be greater support for integration of multiple disciplines. The key concern is around the actual selection of that

which will be retained and that which will be omitted (at any year level). It is expected that this will be a contentious matter as the actual curriculum is developed — the writers will need to be well-armed with a clear and defensible rationale for what is proposed in this area.

- 4.3. An important aim will be to allow teachers to feel that they have time and opportunity to employ appropriate pedagogical strategies (such as student investigations) which promote engagement and use a range of technologies.
- 4.4. Addressing a variety of issues associated with implementation will be critical if the intended curriculum is actually to become the curriculum implemented in classrooms. While the framing paper puts these outside the immediate responsibility of the National Curriculum Board, they will in fact be critical elements for the success of the whole enterprise. Some of the issues identified by AAMT members include:
  - 4.4.1. Teachers must be well-qualified and well supported, and opportunities for high quality, appropriate and sustained professional learning (both pre-service and career-long) will be critical.
  - 4.4.2. The availability of high quality support materials and resources for teachers will also be critical for success. Although passing reference is made to the notion that electronic publication will facilitate access to relevant resources by teachers (paragraph 60), there is no indication of who is considered to be responsible for their development, identification and provision. A sensible aim of national curriculum development would be to reduce the duplication of effort currently invested across the different jurisdictions in Australia – thus it would seem appropriate for provision of high quality curriculum support to be properly addressed at a national level rather than being completely devolved to the states and territories.
  - 4.4.3. Successfully articulating the proficiency strands, in particular, will require not only clarity in the curriculum documentation but also additional support for teachers to develop and employ appropriate approaches to assist growth of students’ problem solving and reasoning capacities etc., and to meaningfully assess this growth.
  - 4.4.4. It is imperative that supporting materials are developed to assist teachers to challenge and extend all students, particularly those with a particular interest in and/or aptitude for mathematics.
  - 4.4.5. Support materials must include exemplars to clarify expectations and possibilities with respect to assessment and pedagogy.
  - 4.4.6. Assessment which is perceived to be “high stakes” (either for individuals, as in the case of final year examinations, or for schools, as in the case of state and/or national testing regimes which influence school reputations and resourcing) will tend to ‘drive’ the curriculum which is actually implemented in classrooms. It is of paramount importance that assessment and reporting practices (including those at state and national levels) be coherently connected with the content and proficiency standards and the numeracy continuum to be specified in the developed curriculum documents. It is the clear responsibility of the Australian Curriculum, Assessment and Reporting Authority to ensure that this becomes practice rather than rhetoric, and that the national curriculum becomes the rigorously applied framework for national assessment.
  - 4.4.7. The use (or otherwise) of technology is a particular area in which external assessment regimes will significantly affect classroom practice. If particular tools are prohibited in examinations (either at the ‘leaving’ level or in state and/or national testing in primary and junior secondary years), then emphasis will naturally be placed on students being able to “do without” these tools, rather than on choosing and using them appropriately. If digital technologies are indeed to be embedded in the curriculum “so that they are not

optional extras” – and the argument in favour of this is compelling (see AAMT Statement on the Use of Calculators and Computers for Mathematics in Australian Schools, downloadable at <http://www.aamt.edu.au/Documentation/Statements/Statement-on-the-Use-of-Calculators-and-Computers-for-Mathematics-in-Australian-Schools> – then it is imperative that assessment schemes be designed to recognise and accommodate this<sup>1</sup>. This is not to say that there is not contention in the field about the concept of mandating the use of a particular technology in an examination setting.

4.4.8. Although there is now uniformity across the states and territories with respect to school starting age and total number of years in formal schooling, this is not the case for students currently in the system. Implementation will need to take appropriate account of state and territory differences in ages and years of schooling experience of current students, particularly if the curriculum is to be specified in a year by year structure (as proposed in paragraph 61).

4.4.9. Implementation needs to ensure the articulation for teachers of the role and utility of developmental frameworks (such as those provided by Count Me In Too, the Early Numeracy Research Project, First Steps in Mathematics etc.) when teaching the national curriculum. Support must also be provided for teachers to engage with the use of such frameworks.

- 4.5. Evidence-based research – from both national and international sources - must be used to drive the construction of the new curriculum. AAMT members endorse the consideration that the national curriculum development process is giving to information such as that provided by the international PISA and TIMSS studies and the stated intention to use a “strong evidence base” (articulated in principle (j) of Appendix 1).
- 4.6. The Association also affirms the principle of access for all students, and the requirement that course structures up to Year 10 ensure that mathematics study in Year 11 remains a genuine option for all. This, however, presents the challenge of ensuring that every student is provided with ongoing opportunities for meaningful mathematical learning and at the same time catering for diversity in students’ educational pathways and interests.
- 4.7. AAMT agrees with the need for curriculum documents to make explicit connections between learning areas. This should include provision of specific descriptions of intersections with other learning areas in the mathematics curriculum documents.
- 4.8. There must be consistency in expectations about students’ mathematical knowledge and skills at each stage across the curriculum documents being developed in different discipline areas. For example, expectations in the history and science documents regarding students’ capacity to read, construct and interpret graphical information must be in concert with the mathematics curriculum expectations of the skills and understandings of the same students. This will entail resolution of current inconsistencies, such as the common introduction of the concept of pH in science courses some years before the notion of logarithms is dealt with in mathematics courses.
- 4.9. The AAMT agrees with concerns about disengagement of students and endorses the intention to address this issue by deliberate attention in the curriculum to fostering engagement and participation in meaningful and productive mathematics learning, particularly in the key middle years, in line with the recommendations of the *Maths? Why not?* report (AAMT, May 2008) and other similar findings.

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<sup>1</sup> “Assessment practice should reflect good teaching practice. The use of technological resources as integral aids to learning assumes their inclusion in the assessment process. New approaches to assessment will be required at all levels to better reflect the realities of learning within a technological society.” (AAMT Statement, 1996)

- 4.10. It is not clear how the curriculum will enable teachers to accommodate the needs of students in a particular year level who have not yet achieved proficiency standards specified for a previous year level(s). This is a critical issue for teachers which must not be glossed over, either in the writing of the curriculum or in the development of supporting materials.
- 4.11. One of the strengths of the framing paper is the statement of commitment to engagement and a focus on “mathematics for all”. This is certainly in concert with the general thrust of the recommendations provided in the 2008 National Numeracy Review Report. Development of the curriculum must also take particular account of Recommendation 3 (that greater emphasis be given to higher-level mathematical problems) and Recommendation 8 (that the language and literacies of mathematics be explicitly taught by all teachers of mathematics). Many other issues identified in the report will have significance in the implementation stage for the new curriculum, including such things as: the need for balance in emphasis between systemic assessment programmes and high quality classroom based assessment; the need for adequate learning time devoted to mathematics for all students; the need for resources to support teachers’ use of diagnostic tools; the requirement for resources to support teachers to provide appropriate intervention; the extension in reach and impact of exemplary research-based professional development programmes for teachers; and the need for increased support for teachers teaching secondary mathematics ‘out of field’ as well as for teachers to exercise effective leadership roles in numeracy and mathematics within schools.
- 4.12. Many members of the AAMT express concern that the commitment to “mathematics for all” may be interpreted in ways that result in students with aptitude and interest in mathematics being disadvantaged by not being extended. This is related also to concerns about the “thinning of the curriculum”; and the notion of a common curriculum experience for all students until the end of year 9. Current practice, within a curriculum that is too crowded for the majority of students, can see unstreamed classes move quickly from topic to topic in order to “get through the content”. The best students are able to learn the material quickly enough to be able to move on in their learning. In this way they are continually being challenged; the rest of the students receive, at best, sketchy understanding when they have insufficient time to learn what is required. If, on the other hand, an unstreamed class moves at a pace more suited to the ‘average’ students, the best students are not extended. The approach of a trimmed curriculum, with the opportunity for some students to work with the same mathematics at greater depth while their peers learn the important fundamentals would seem to provide challenges for all students in an unstreamed class. Many teachers and schools will need substantial support for this change (see also 5.6.4)
- 4.13. The AAMT welcomes the emphasis on appropriate use of digital technologies being embedded in the curriculum. As a necessary corollary, the documentation must recognise that the interaction between technology and curriculum is dynamic, and that the rapid pace of technological change will necessitate constant critical analysis and evolution of what is done in the name of school mathematics. In addition, it should be recognised that new and emerging technologies provide not just new tools for doing mathematics, but also new possibilities for pedagogical approaches (for example, the opportunities afforded by Web 2.0 tools and technological support for collaborative classroom experiences).
- 4.14. The Framing Paper does not address the question of whether mathematics study will be required of students in senior secondary school. The explicit statement about Year 10 mathematics being compulsory (paragraph 65) leaves open the question of compulsion or otherwise in subsequent years. This will need to be resolved in the development of the curriculum.

- 4.15. Additional important considerations are the ‘shelf life’ of this curriculum and appropriate processes for renewal. These should be addressed at this development stage, so that plans are in place for collection of a sound evidence base from which informed revision can occur.

## **5. Structure of the curriculum**

### **5.1. Stage 1**

- 5.1.1. The significance of algebra learning in the early years should be explicitly recognised. The reference to algebra in the primary years in the current version of the Framing Paper (“An algebraic perspective can enrich the teaching of number in the middle and later primary years”) is insufficient. (see comments in 3.3 above)
- 5.1.2. Many students enter schooling with a great deal of mathematical understanding. The curriculum must not be limited to “foundational” ideas, and must encourage teachers to identify what each student already knows and can do and continue to build on this. Building on this requires teachers to explicitly identify (for themselves and their students) the key mathematical concepts the students need to learn — the curriculum itself needs to be similarly explicit and unambiguous.

### **5.2. Stage 2**

- 5.2.1. The AAMT endorses recognition of the twin challenges at this stage of making the curriculum engaging and preparing students for future study.
- 5.2.2. There has been a great deal of research and development in understanding of the learning of mathematics, particularly in the area of number, in primary school (and early years) which will serve as an evidence base. The findings, such as those around subitising and partitioning, using deep understanding of whole numbers to build understanding of fractions and decimals, and development of conceptual understanding of place value, need to be carefully embedded in the way the curriculum is articulated.
- 5.2.3. The structure of the curriculum in the number and algebra strand, in particular, should not be governed by artificial limits such as, for example, the addressing of numbers to a certain size at a particular year level. Rather, it should identify “a clear conceptual pathway that shows how children’s understanding of number becomes increasingly sophisticated”.

### **5.3. Stage 3**

- 5.3.1. The AAMT commends and concurs with the stated intentions, in particular that the curriculum will be compulsory and inclusive for all students to the end of Year 10; that content will be meaningful and relevant for learners; that important ideas will be identified and focussed upon; that students should be well-prepared for future study in mathematics; and that provision should be made for extending and challenging all students.
- 5.3.2. Students need to develop deep understanding of algebra with adequate time made available to use algebraic modelling and applications. This implies the need to identify algebraic modelling and applications among the ‘big ideas’.
- 5.3.3. In the light of the data-driven information age into which the students will move as adult citizens and workers, they need time to develop critical statistical literacy skills that must be specifically identified among the “big ideas” of the curriculum.
- 5.3.4. The AAMT endorses the notion of using challenging problems posed using basic content as the means of extending students. However, extensive support for this approach must be provided to teachers in easily accessible support materials.

5.3.5. The Stage 3 curriculum should emphasise building on existing knowledge and skills developed in primary school, and not on repetition.

5.4. **How many mathematics courses for the senior years of schooling should be included in the national mathematics curriculum?**

5.4.1. The intention to provide multiple categories of course, with one or more of these designed for students preparing for pathways that do not require the use of scores in such courses to be used in university selection processes, seems sensible. It is not clear whether all the students who are not bound for university (the majority of our students) will all be catered for in a course with a “vocational” orientation. It may be that a fifth course with a “numeracy for citizenship” orientation is needed. However this particular matter is resolved, such a structure will result in continued challenges for implementation in all but the largest schools and will require considered effort to ensure that all students have genuine opportunities to pursue the course of their choosing. It seems to the AAMT that more work needs to be done to resolve the issue of the purposes of mathematics in the senior secondary years. It is only then that there will be a basis for a rational resolution of the practical issues that are tied up in the discussions about “the number of courses”.

**6. Other comments**

- 6.1. Care must be taken to ensure that there is a real focus on pedagogy and not just on what content is to be taught. Whilst this must be evident in supporting documents, and in support for high quality pre-service and also career-long professional learning, the writers of the curriculum have a responsibility to do nothing that militates against the use and promotion of well-founded contemporary pedagogies in mathematics.
- 6.2. It is appropriate that the mathematics curriculum be for all students, with emphasis on adapting activities to enable success for students experiencing difficulty and to extend and challenge students for whom this is appropriate. However, this will require careful structuring of the curriculum to clearly articulate the ‘big ideas’ and also provision of adequate support for teachers to assist them to recognise the type of adaptation required and to develop appropriate approaches and strategies. It is vital that the intention is not able to be misinterpreted as a “one size fits all” approach.
- 6.3. Although the ‘Shape of the National Curriculum’ document indicates that states and territories will be able to continue to accredit special schools using curriculum adapted for the needs of their students, there is no mention in the current documentation of the possibility for exemption from use of the national curriculum of some individual students in mainstream schooling. It must be assumed that there will be some students whose special needs require the development of individual specialised programs, but any identification of a student requiring a modified curriculum should be done carefully on a case by case basis, with the needs and opportunities for future learning of the individual student being paramount.
- 6.4. AAMT endorses the implicit acknowledgement of the centrality of teacher professionalism and informed judgement in matters of pedagogy and assessment. Support (including time and provision of professional learning opportunities as well as high quality materials) for teachers to reflect on, develop and extend their capacity in these areas is essential.
- 6.5. AAMT notes that it is the intention that appropriate use of technology will be an expectation in all courses, including the use of dynamic geometry packages, educational statistical software and computer algebra systems (whether on a computer or hand-held device) in mathematics courses, and endorses this direction. (see also the AAMT Statement on the Use

of Calculators and Computers for Mathematics in Australian Schools (1996) mentioned in 4.4.7 above)