National Consistency in Curriculum Outcomes

Mathematics Statements of Learning

The AAMT response to the question

Is the Statements of Learning document sufficiently forward-looking to be the basis for mathematics curricula in the second decade of the 21st century?

Executive Summary

The Australian Association of Mathematics Teachers Inc. has consulted its members and invited their input to inform this detailed analysis of the document *Mathematics Statements of Learning* published by MCEETYA in August 2006. The key findings from this analysis are that:

1. The process of developing the *Statements* did not include sufficient consultation with stakeholders. This was due, at least in part, to the extremely short timeline for the project. The lack of effective consultation has been a major contributor to the general lack of quality in the document. The AAMT is concerned that the National Assessment Programme — which will logically be based on the *Statements of Learning* — will be significantly compromised in its quality as a result of deficiencies in the *Statements*. It is also unacceptable to us that the development of the NAP is proceeding with a similar lack of consultation with relevant stakeholders.
2. The assertion that teachers are not a primary audience for the document does not recognize that contemporary views of the teaching profession identify curriculum development as one of teachers' critical roles. The likely connection with the forthcoming NAP makes it even more important for teachers to be familiar with the intent of the *Statements* as a curriculum document.
3. The *Statements* are essentially based on — what is common to — curriculum documents in the states and territories that are in turn derived from thinking in the late 1980s (ie the *National Statement* and *Profile*). Hence the *Statements of Learning* are inevitably backward-looking and unable to meet the needs of students and teachers in the knowledge era of the 21st century.
4. The term 'opportunity to learn' is central to the *Statements* and their use. The term is poorly defined and described and can only lead to uncertainty in the field. The concept includes expectations for Year 7 that are beyond the resources of three states to deliver at an appropriate level of quality.
5. The combining of measurement ideas with those that underpin statistical literacy in a single organizer (or strand) does not reflect the separateness,

and increasing importance, of the latter for students who will be citizens and workers in the knowledge era.

6. There is an emphasis in the *Statements* on Working Mathematically within expressly mathematical contexts. This is not an appropriate balance for the *Statements* — a greater emphasis is needed on mathematical modeling and applying mathematics to the students' physical, social and environmental worlds.
7. The *Statements* present mathematics learning is an individual pursuit — cooperative and collaborative learning — both as a pedagogical approach and embedded in intended learning outcomes — are essential in a balanced, contemporary mathematics learning program.
8. The treatment of ICTs as a means for doing and learning mathematics is inadequate. This is true both in the extent to which these technologies are referred to in the *Statements* on Working Mathematically as well as the delay of any meaningful mention of technology until the end of the primary years. The significant role that technology has played in changing mathematics in recent decades is not reflected in the *Statements*.
9. The *Statements* fall well short of 'introducing and developing the mathematics which is the essential underpinning of students' numeracy. The deficiencies noted above on Working Mathematically as well as the use of technology and individual (as opposed to collective) ways of doing and learning mathematics are the key issues to address.
10. The *Statements* present inappropriate conceptual development in relation to several aspects of mathematics. These include (but are by no means limited to):
    - The introduction of formal algebra in the *Statements* for Year 7 does not take account of the research evidence for delaying the formal syntax and semantics of algebra;
    - Students' use of counter examples to disprove proposed general statements being deferred until the end of primary school; and
    - Numerous other cases across the aspects of mathematics in which the treatment becomes abstract much more quickly than is sensible, given the need to keep students 'on board' with their learning of mathematics.

Introduction

The *Mathematics Statements of Learning and Professional Elaborations* (the Statements) were published in August 2006, after endorsement by the Ministerial Council on Education, Employment, Training and Youth Affairs (MCEETYA).

The Australian Association of Mathematics Teachers Inc. (AAMT), as the organization representing the professional interests of teachers of mathematics in schools, has an obligation to analyse and report on national curriculum development initiatives such as the *Statements*. This paper is the summary of this analysis.

The AAMT takes the view that the process used to develop the Statements was extremely rushed and not widely consultative with relevant stakeholders. This includes significant changes made to the penultimate draft without explanation, or opportunity for a jurisdiction to challenge these before the final 'sign-off'[1]. This paper does not discuss in detail what are seen as the flaws in that process — our attention is on the resultant document and its potential impact on the teaching and learning of mathematics in our schools. It is worth noting, however, that current work to link the *Statements* to 'national standards and testing'[2] appears to be proceeding with similar lack of consultation. This is not conducive to an expectation that the work on assessment will reach the high standards our community deserves, through a process that draws on and involves the expertise of stakeholder groups such as the AAMT.

This paper has the following sections:

- the underpinning conceptualisation of the *Statements*;
- comments on the 'definitions' adopted;
- the treatment of Working Mathematically;
- the development of mathematical concepts over time; and
- the capacity of mathematics as described in the *Statements* to underpin the development of students' numeracy.

Section 1 — Conceptualisation of the *Statements*

Looking backwards

There is a fundamental contradiction between identifying that which is 'common' in curriculum content — or that might be common by January 1 2008 — and the expectation that education authorities will provide a curriculum that is forward-looking enough to anticipate the needs and modes of learning of students in the knowledge era of the 21st century. The current *Statements* are

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[1] As reported by members is one state where the mathematics teacher association was invited by the authorities to comment on the materials during their preparation. The view expressed on the basis of this involvement was that the project had an 'indecent timeline'.

[2] This vague language — 'standards' for what? etc. — is what is used on the MCEETYA website (http://www.mceetya.edu.au/mceetya/default.asp?id=11893)

inevitably backward-looking. They look at current curriculum documents to identify that which is the common 'core'; and essential.

The lack of consultation in the process of developing the *Statements* inevitably raises the question of 'essential' — in whose eyes? As a result, the *Statements* do little to address the 'crowded curriculum'. The concept of '"less is more" in relation to curriculum content and coverage' is identified as a positive direction by Luke et al (2003; p. 47) in their review of middle years research. This approach has been found to provide better scope for deep and connected learning in mathematics — the opportunity to pare back the content of school mathematics has not been taken by the *Statements*.

Year-level related *Statements*

The identification of statements that are year-level related (ie at Years 3, 5, 7 and 9) is incompatible with contemporary views of developmental learning based on sound theories of learning and research. Every effort needs to be made to keep young people progressing in mathematics, and positively disposed towards further learning of mathematics if Australia is to meet its requirements for an appropriately skilled workforce, whether at the professional, trade or semi-skilled level. Linking expectations to year levels has in the past ensured that those students who do not 'measure up' do not see mathematics as part of their future. Australia cannot afford to shed its intellectual capability in this way. The AAMT supports setting high expectations for all learners. This requires commitment to assisting students who require help to move on in their learning.

Audience

The *Statements* are written with State and Territory curriculum authorities or departments as their 'primary audience'. This implies that teachers are a 'secondary audience', at best, thereby denigrating their role as developers of curriculum that matches the explicit needs, interests and aspirations of their unique groups of students.

The *Statements* have been written for Years 3, 5, 7 and 9 — teachers must develop the curriculum for their students for the other year levels. Hence there is an expectation in the *Statements* that teachers will be curriculum developers. This is a confusing stance, made worse by not including teachers in the writing of the *Statements*. Yet this expectation was not extended to teachers through their inclusion in the writing of the statements

This is a curious position at a time when all jurisdictions are concerned to enhance the professionalism and status of teachers. One of the key characteristics of teachers as professionals is that they are vitally concerned and involved in discourses about curriculum, yet this process has excluded teachers' views. Further, the likely connection with a testing regime for their students compels professional teachers to be informed about such developments. It is also naïve to expect that teachers will not use the *Statements* in 'preparing' their students to demonstrate their learning through forthcoming national tests, and to use the Statements to reinforce their understanding of the intentions of the curriculum.

Opportunity to learn — reasonable, challenging and appropriate

The concept of 'opportunity to learn' has not been common in Australian education. Its use in this context leaves unanswered several basic questions. Does it mean that students have one such opportunity? Two? More?...are students required to have had their 'opportunity' by the end of Year 3, 5 7 and 9? Or the beginning? Or May 18?...Does the requirement that students merely be *taught* (ie have the 'opportunity') absolve teachers from responsibility that students should *learn*?...What implications does this have for pedagogy and teaching practice?

Further, 'opportunity to learn' as described in the Statements raises some other issues. It is defined 'as those opportunities seen as reasonable, challenging and appropriate'. The adjectives 'reasonable', 'challenging' and 'appropriate' are unproblematic in themselves in describing the complex balance that is required in designing curriculum. The problem in the context of the Statements is the need to translate them into the year level delineations.

The term **'appropriate'** is defined as 'suitable for the majority of young Australians to experience'. Hence the Year X *Statement* mandates that the majority of students will have the opportunity to learn an aspect of mathematics. The idea of the 'majority' is used without any definition of, for example, those students who will not be expected to be excluded from the expectation due to a learning disability. The AAMT sees equity served by insisting that this should be qualified as a 'significant' or 'vast' majority, rather than leaving the opening for a simple majority of students having the opportunity to learn as sufficient to meet the criteria[3].

The different year levels for the transition between primary and secondary phases of schooling in the various jurisdictions also makes some aspects of the *Statements* not 'appropriate'[4]. It is not feasible to expect primary teachers to introduce the ideas of algebra in the *Statements* at Year 7 to their students. Primary teachers do not have — and should not be expected to have — background mathematical knowledge or content pedagogical skills to teach the algebra in the *Statements* at Year 7. Given the importance of algebra to students' mathematical development it would be a very negative step to insist that their first experience with the topic be with a teacher without the necessary background to teach the formative ideas well. Similarly, in these jurisdictions the expectations around the use of technologies in the Year 7 Statements is not compatible with the skills of primary teachers, let alone the availability of the actual technologies is schools.

The term **'challenging'** indicates that the learning will be 'a stretch' and 'represent somewhat more than a proficient student could be expected to learn initially'. In some instances the *Statements* express this 'somewhat more' in conceptual terms — ideas that most students do need to come back to in order to

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[3] The sense of 'all students' in expectations around the Benchmarks would seem a more appropriate meaning for 'appropriate'.

[4] Students in Queensland, Western Australia and South Australia commence secondary schooling in Year 8; in other jurisdictions this occurs in Year 7.

build deep learning. For example, from the Year 5 *Statements* (Algebra, pattern and relationship)

Students make generalisations associated with the four operations that are built upon properties (commutative, associative and distributive) and inverse operations.

In other areas 'somewhat more' appears to mean that there is so much 'stuff' that it will take a while for the students to cover it satisfactorily. As an example, again from the Year 5 *Statement*, (Measurement, chance and data)

Students measure, compare and order lengths, areas, volumes, angles and masses by selecting and using suitable informal or formal units (millimetres, centimetres, metres, square centimetres, square metres, millilitres, litres, degrees, grams, kilograms)

Any selection from these lists such as *compare angles using degrees* or *measure masses using grams* does not seem too much of 'a stretch' — it is the size of the task (ie all the attributes; all the units) that creates the 'challenge' for curricula[5] and therefore teachers in the classroom.

In either case, 'somewhat more' could be taken to imply pressure on students to learn in a limited time. Pressure of this kind is not consistent with developmental, inclusive, student-centred learning

The term **'reasonable'** is interpreted as being 'realistic to expect that most students will have actually achieved the learning within a reasonable period of their first having the opportunity to learn…up to two years can be considered reasonable for students.' This will probably provide clear guidance for designers of national tests at Years 5, 7 and 9 as we are led to believe these will be based on the *Statements* for Years 3, 5 and 7 respectively. Such a blanket decree on the time taken for students to learn mathematics after it has been adequately introduced by providing students with opportunities to learn at least two years earlier is not helpful. It is likely that most students will need opportunities to learn the content in the period leading up to when it tested. There is nothing in the *Statements* about this.

The purported 'pedagogical neutrality' of the *Statements*

The *Statements* indicate that they 'do not attempt to address pedagogical issues.' This may have been the intention, but it is not possible to avoid doing so in such a document. 'Pedagogy' is essentially about the theory of teaching, and there are many ways in which the *Statements* do imply, suggest and perhaps require a certain pedagogy. For example, the emphasis in the *Statements* on students doing and learning mathematics as individuals clearly determines an approach to the learning of mathematics (ie a pedagogy). Similarly, the use — or, more precisely, lack of use — of technologies in the mathematics *Statements* is a pedagogy. So is the approach to literacy development in the *Statements*.

[5] The sense that the mathematics curriculum is crowded is reinforced by this sort of description of content. The different attributes and associated units are relatively trivial consequences of the conceptual learning about measuring, ordering and comparing as mathematical activities that quantify the world.

Section 2 — Definitions in the Statements

School mathematics

The section on *School Mathematics* in the Statements claims that 'States and territories have expressed a range of views on mathematics and mathematics education, with corresponding diverse interpretation and representation in curriculum design.' This implies that well-informed mathematics educators have widely differing views. The AAMT asserts that this is not the case. There are far more similarities than difference, and it is these similarities that are played out every day in mathematics professional development and classroom practice across the country.

Clearly there are some differences in content between the various state and territory mathematics curricula — if there weren't this document would not be needed. But at the level of broad views on mathematics the AAMT does not see evidence of great variation between the jurisdictions. Every jurisdiction has had at least one major redevelopment of its mathematics curriculum for schooling up to Year 10 in the last ten years or so. These curricula share a philosophy that is based in that of the *National Statement* and *Profile*.

This section of the *Statements of Learning* identifies four 'broad underlying themes' in state and territory mathematics curriculum documents:

- Mathematics is dynamic;
- Mathematics is an integral part of a general education;
- Mathematics contributes to individual and collective development; and
- Mathematics connects with other curriculum areas.

The text discussing each is clear and unproblematic. The AAMT supports these themes as being a reasonable set, although the last seems somewhat too school bound — it would have been better expressed as '…with students' lives and their worlds' (or similar). This includes 'other curriculum areas' as these are part of what students do in their lives; but is more general and accurate in its depiction of the view of the various mathematics curricula around the country.

These themes do have implications, however. Each suggests — demands, even — that what is done in the name of mathematics in schools needs to change and evolve. *Mathematics* as a discipline is constantly changing, perhaps more in the last 30-50 years than ever before. School mathematics needs to reflect that. Social change has been rapid and is accelerating as we embrace the 'knowledge era', with *general education* constantly evolving in response. School mathematics must respond to these changes. One effect of accelerating social change is constant change in the nature and needs for *individual and collective development*, whether this is in the nature of work and career growth, social engagement or what is valued in society. School mathematics must be part of these changes. As *other curriculum areas* change, so must school mathematics.

These themes and their implications are the metric used by the AAMT in its analysis of the *Statements* document. The *Statements* are essentially based on — what is common to — curriculum documents in the states and territories that are

in turn derived from thinking in the late 1980s (ie the *Statement* and *Profile*). Hence the *Statements of Learning* are inevitably backward-looking[6]. This contradicts the theme that 'mathematics is dynamic'.

Mathematics curriculums in Australia — four aims

In this section the document identifies its 'aims' — what the Statements 'are intended to provide the students with the opportunity to learn and develop' at the broad level. There are four of these.

Content

The first set of aims deals with what might be termed mathematical 'content':

knowledge and understanding of concepts and ideas, and facility with mathematical skills and processes across key areas of mathematics with:

- mental and written computation and numerical reasoning
- function and pattern, generalisation, logical and algebraic reasoning
- the identification and measurement of attributes or characteristics of shapes, objects, data and chance events
- geometric reasoning and the visualisation, representation, location and transformation of shapes and objects in space

(*Statements* p. 2)

The four dot points reflect the four 'strands' that have been used as organizers of mathematics 'content' in the *Statements*. This particular collection is *not* used in any mathematics curriculum document in Australia nor in the *National Statement* or *Profile*.

In particular the merging of two commonly used organizers (*measurement* and *chance and data*) in the third dot point is not appropriate. The 'knowledge era' heightens the importance of data and the capacity to deal with it. Forward-looking curricula need to have separate and substantial treatment of statistical thinking and techniques — more than ever before. It is noteworthy that the other three strands explicitly include a reasoning element ('numerical reasoning' etc.). The merging of measurement and chance and data seems to have precluded the inclusion of 'statistical reasoning' and the 'analysis of risk', yet this is a critical component of current and future citizenship.

It has been suggested that these organizers do not have any 'status' and will not be used. They exist, however, and the uncertainty about the links to national testing raises the concern that these organizers will be used in some ways. That, in turn, could send the wrong message — to teachers in particular — about the importance and independence of these two areas.

Working Mathematically

[6] This is not a negative comment about the *Statement* and *Profile*. They were exemplary, world leading documents of their times, but they must inevitable have a 'shelf-life'.

The second group of aims covers a range of process capabilities that form part of what is commonly termed Working Mathematically (or similar) in state and territory mathematics curricula.

the capacity and disposition to deploy mathematical knowledge, understanding, skills and processes in a range of situations through

- using and building on prior knowledge, generalising to other contexts, making conjectures and incorporating new information into existing structures
- posing and solving problems, mathematical modelling, developing proofs and conducting investigations
- thinking creatively, generating alternatives when solving problems, and working individually and cooperatively
- reflecting upon and discussing mathematical ideas, problems and processes, to formulate and test their own solutions, and have these tested by others
- evaluating representations of mathematical information and challenging mathematical ideas by considering purpose and point of view

(*Statements* p. 2-3)

While the 'range of situations' hints at applications of mathematics to physical, environmental and social contexts, and mathematical modeling is mentioned (second dot point), the overwhelming sense of these statements is about working mathematically within expressly mathematical contexts. This is not an appropriate balance for the *Statements* — a much better balance between learning to use mathematics within and outside of school mathematics is required.

Communication

The next set of aims is about communication in mathematics. This is an important aspect of doing and learning mathematics at school, and of the mathematical capability needed by citizens.

the capacity to communicate effectively through:

- the use of informal and formal mathematical language to convey, logically and clearly, their mathematical understandings, thinking and reasoning in oral, electronic and written media
- representation of their mathematical ideas and reasoning in different ways which reflect their conceptual understandings for various audiences and purposes
- the selection and effective use of a range of mathematical strategies, models, information and communication technologies and related critical literacies

(*Statements* p. 3)

The phrase 'related critical literacies' in the last dot point is not at all clear — to what are the 'critical literacies' related?; is not 'effective use of (mathematics)' in itself an essential component of critical literacy in the knowledge society? Further, this sense that mathematics is not related to 'critical literacies' is also evident in the first dot point. This does not give any sense of a 'critical' orientation through the presentation of their own case or argument based on

mathematical reasoning, or the analysis of others' arguments, again using mathematics.

Affective

The last aims could be characterized as being in the affective domain — aims like this are, indeed, typically included in Australian mathematics curriculum documents. Anecdotal and other evidence would suggest that it is seldom realized for all students (or even a majority) in practice[7].

enjoyment of mathematics and confidence in the use of mathematics in everyday situations through appreciation of

- its relevance as part of their personal and working lives
- its nature as a dynamic, diverse and complex domain with interwoven and interconnected concepts
- the nature of mathematical thinking and its historical and cultural roles

(*Statements* p. 3)

The focus on 'personal and working lives' in the first dot point serves to highlight the scant treatment of applications of mathematics in the second set of aims. It is not possible for students to appreciate the relevance of mathematics in their personal and working lives without many and varied experiences that enable them to develop that appreciation.

Features of *Statements of Learning for Mathematics* and the *Professional Elaborations*

The descriptions of the organisers that come next in the *Statements of Learning* have at least three fundamental flaws.

- The lack of balance in the description of Working Mathematically between 'within mathematics' and 'applying mathematics to physical, environmental and social contexts' is apparent in the description of Working Mathematically. This is discussed above and is unacceptable.
- The joining of measurement and chance and data (also commented on above) is a completely inappropriate construction. At a time when the importance of statistical literacy is increasing for all citizens it is unthinkable that mathematics curricula up to year 9 or so should downplay foundational learning in the area in this way. If anything, the statistical/chance and data area of the curriculum should be given increased emphasis in the future. The sentence in the outline that treats length, area, volume, angle, mass, time, temperature (attributes of the physical world) as directly connected to probability and statistics (mathematical fields) is a nonsense.
- Function and pattern are components of the field of algebra. Hence the title 'Algebra, function and pattern' is illogical as it stands. It should be

[7] Note that this overall short-coming in the outcomes for students is in the context of the very curricula on which the *Statements* are based. How will the *Statements* achieve these outcomes if those curricula cannot?

either just Algebra, or Function and pattern; or perhaps Function, pattern and algebraic manipulation (if the latter set of skills is seen as important to include and is conceptualized as not part of 'pattern' — it would be difficult to sustain an argument for either of these, however)

Further, the statement in this section that 'systems over time will integrate the *Statements*…into their curriculum documents' seems to imply a process of some duration. This is at odds with the requirement that ministers will need to sign off that this integration is complete by 1 January 2008. This sort of timeline could force the state and territory authorities to abandon their current consultative processes with teachers. This would be an unwelcome development.

Section 3 — Working Mathematically

The AAMT views the expression of knowledge, skills and attitudes around Working Mathematically as one of the key concerns in mathematics curriculum design in this country. Historically, the *National Statement on Mathematics for Australian Schools* (Australian Education Council with Curriculum Corporation, 1991) identified three strands (sub-strands included in parentheses):

- Mathematical inquiry (*Mathematical expression, Order and arrangement, Justification* and *Problem solving strategies*)
- Choosing and using mathematics (*Applying mathematics* and *Mathematical modelling*)
- Attitudes and appreciations (*Attitudes* and *Appreciations*)

The learning described in these has, by and large, been transported into the concept of Working Mathematically as expressed in more recent curriculum documents in the states and territories.

Against this backdrop, the AAMT sees the *Statements* on Working Mathematically as deficient in a number of ways:

- The inadequate emphasis on the use of mathematics in the physical, environmental and social worlds is evident in the definition of Working Mathematically (see Section 2). This is, if anything, even more pronounced in the detail of the actual *Statements*. The *Statements* can be described as mathematically 'pure', without any real sense that the students might be doing much in the name of mathematics that actually matters to themselves.
- The *Statements* give strong emphasis to the view that mathematics learning is an individual pursuit — cooperative and collaborative learning are essential in a balanced, contemporary mathematics learning program. This would be relatively simple to rectify by including in the *Statements* content such as '*collaboratively* plan which data to collect.'
- The capacity to capture development in this area of mathematics learning is especially difficult. The idea of 'counter-examples' as a means for establishing that a proposed general statement is false is not introduced as an opportunity to learn until Year 7. The use of counter examples — and of deduction (this is also first mentioned explicitly in the Statements for

Year 7) — are fundamental to Working Mathematically and in our view should be required to be introduced much earlier than Year 7. Indeed, these ways of thinking would seem to be fundamental to the Year 5 Statement that 'students make and test straightforward statements, propositions and conjectures as they…'.

- The treatment of ICTs as a means for doing and learning mathematics is inadequate. This is true both in the extent to which technology is referred to in the *Statements* on Working Mathematically as well as the delay of any meaningful mention of technology until the end of the primary years. There is nothing in the Year 3 statements; at Year 5 they communicate 'how they may have used technology'; the year 7 and Year 9 Statements indicate that they 'use technology as appropriate to assist mathematical inquiry and in presentation…of their work'.

  In this matter the *Statements* at Years 3 and 5 in particular are inconsistent with the recommendations in *A National Statement on the use of Calculators for Mathematics in Australian Schools* (Curriculum Development Centre and AAMT; 1987) as endorsed by all education jurisdictions and the National Catholic Education Commission at that time. This consensus statement recommended that, among other things, '**all** students use calculators at **all** year levels K-12' (their emphasis), 'the calculator be used both as an instructional aid and a computational tool in the learning process' and 'curriculum change in content and methods arising from calculator use'.

  Further, and extending the notion of 'technology' in mathematics beyond calculators it would seem that the Statements see no place for the content provided through The Le@rning Federation in the earlier years of primary school in particular, despite that project being a major national initiative, with substantial funding over several years.

  The expectations for Year 7 cause concern for those states in which Year 7 students are in primary settings. These schools do not typically have access to the kinds of graphing and geometrical software that would be required to provide students with the necessary opportunities to learn. Teachers in these schools generally will not therefore have the mathematical, technological or pedagogical skills to teach the students the material required by the *Statements* for Year 7.

There are also some problematic and/or unhelpful statements in the *Statements of Learning* for Working Mathematically. Some of these are:

- The mention in Year 5 that 'students…begin to link (their exploration of new mathematics) to existing knowledge' suggests that, prior to this, students will not have had the opportunity to learn such linking. This is not a credible stance to take on learning of mathematics or anything else.
- The use of terms like 'simple' and 'straightforward' is not helpful as they are only ever contextually defined for an individual (ie what is simple for one child may be complex for another etc.).
- The Year 9 *Statement* suggests that students have an opportunity to learn to 'attend to the nature, purpose and scope of (their) communication

(about mathematics)'. This sort of orientation to *any* communication is fundamental to being literate. Literacy educators (including teachers of mathematics at all levels) would be likely to disagree with any suggestion that this fundamental component of being literate be delayed until secondary school.

- The matter of the location of opportunities to learn 'formal' algebra in the opportunities to learn in Year 7 is a major concern that is discussed more fully below (see Section 4). The suggestion in the *Statements* for Year 7 Working Mathematically that students 'interpret and evaluate symbols used to represent variable in simple algebraic expressions and formulas' is not feasible in those states in which Year 7 is in primary settings

There is also repetition from year to year that will surely make problematic the incorporation of the *Statements* in a sequenced manner in state and territory curriculum documents. For example, the fourth paragraphs in the *Statements* for Year 7 and Year 9 are essentially the same.

In summary, the AAMT sees the current description of Working Mathematically in the *Statements* as lacking the substance and clarity to assist the further development of curriculum to support Australian students' development of robust approaches to doing and learning mathematics in and beyond school in the 21st century.

Section 4 — Conceptual development in the strands (*Statements* and *Elaborations*)

The overwhelming sense in the document is that it shows a progression that becomes too formal and abstract too quickly. The aim for school mathematics education in the 21st century needs to be to ensure 'deep' learning of mathematics — 'cohesive conceptions of mathematics (that) are associated with deep approaches to learning mathematics…. students holding cohesive conceptions of mathematics adopt deep approaches to learning mathematics'[8] — rather than superficial, procedural approaches and conceptions of the discipline. While the need for students to move to more abstract conceptualisations of mathematics this can only be successful when the pace of this development is compatible with the student's capabilities. It cannot be rushed and be successful.

Some examples of this too rapid development are:

Year 3

Place value. No mention is made of decimals, although students would be expected to use these in everyday life, in their interactions with money.

The CensusatSchool project, targeted for Years 5 – 10, is given as an example of an elaboration in Measurement, chance and data.

[8] Gilbert, R. & Macleod, H. 2006. *An analysis of the current suite of QSA Years 11 and 12 syllabuses.* Report to the Queensland Studies Authority.

Year 5

Concave, convex, acute, obtuse and reflex angles, results of combinations of transformations, visualisation and constructions of nets of prisms and pyramids

Conversions between units

Tables, graphs and symbols,

Associative, commutative and distributive properties, fraction work proceeds to abstract concepts too quickly eg mental calculations with fractions.

Year 7

Hypotheses, conjectures and propositions

Variation in data, calculation and comparison of measures of location, noting possible causes of bias, distinctions between 'samples' and 'populations' and between 'discrete' and 'continuous' data

Time calculations, including time zones

Compass and straight edge constructions, congruence, planes of symmetry and angles of rotation, scale needs to be scoped more appropriately.

Year 9

Factor trees, irrational numbers, non-terminating decimals, scientific notation

Compound interest

Non-linear functions should be restricted to quadratic and simple exponential functions; solution of simultaneous equations, index laws

Contour maps, networks.

Another deficiency in the *Statements of Learning* is the quality and appropriateness of some of the *Professional Elaborations*, including some instances of contradictions with the *Statements* they are supposed to 'elaborate'. Some examples include:

Year 3

The examples in the elaborations for Working Mathematically are too symbolically driven — more appropriate to use word at this stage to describe relationships.

Inverse operations at Year 3 should be restricted to addition and subtraction only — multiplication and division are still developing ideas

The reference to using technology to access data is an issue of equity/access here; the reference to the CensusatSchool data is inappropriate as these resources are designed for Years 5 – 10.

Year 5

The visualisation and construction of nets of prisms and pyramids is beyond what is appropriate and expected for Year 5 students, as is consideration of the results of combinations of transformations.

Year 7

In the Elaboration for Working Mathematically the fourth dot point in the second elaboration is extremely confusing. The example doesn't match the explanation of the dot point. The discussion of different number bases in year 7 is well beyond expectation.

The third Elaboration in Measurement, chance and data introduces the notion of time zones in schedules and the calculation of elapsed time in practical situations is beyond the expectation of year 7 students

In the Elaborations for Space, lines of symmetry are appropriate, but the reference to points and angles of rotation is not.

Year 9

Second Elaboration for Space is quite complex in its requirements — discussion of the properties of 3D shaped from their isometric drawings is not consistent and is well beyond year 9, as is the reference to constructions using slant edge.

Section 5 — the Statements and students' numeracy development

'Numeracy' as a term has been extensively adopted by politicians, policy makers and educators over the past 10 years in particular. School mathematics requires clear articulation to ensure there is a common sense of purpose for school mathematics and numeracy as distinct yet connected educational constructs.

The AAMT believes that the issues of the relationships and interdependency between school mathematics and students' numeracy development needs to be the subject of further discussion and debate that informs approaches to curriculum, teaching, learning and assessment. In the absence of the outcomes of that debate and discussion it is appropriate refer to the AAMT's current position on numeracy — *Policy on Numeracy Education in Schools* (AAMT; 1998).

That AAMT document notes that mathematics curricula 'should aim to develop…conceptual understanding and build the capacity and confidence to use mathematics'. As indicated above the approach in the *Statements* to Working Mathematically does not highlight uses of mathematics and connection with the physical, environmental and social worlds. These shortfalls indicate that the *Statements of Learning in Mathematics* do not sufficiently meet this requirement.

It is in the Working Mathematically domain that much of what should underpin students' numeracy development should be learnt. Hence other deficiencies noted above such as the inadequate emphasis on the use of technology and the Statements' individual (as opposed to collective) focus confirm the AAMT's view that the they fall well short of 'introducing and developing the mathematics which is the essential underpinning of students' numeracy (AAMT policy).'