



Position paper on

# The practice of assessing mathematics learning

## Preamble

The AAMT *Standards for Excellence in Teaching Mathematics in Australian Schools* (2002; 2006) describe how highly accomplished teachers assess their students' learning:

*Excellent teachers of mathematics regularly assess and report student learning outcomes, both cognitive and affective, with respect to skills, content, processes, and attitudes. They use a range of assessment strategies that are fair, inclusive and appropriate to both the students and the learning context. They maintain on-going, informative records of students learning outcomes that are used to map student progress and to plan future learning experiences. The excellent teacher of mathematics provides constructive, purposeful and timely feedback to students and their parents, and to school authorities as required.*

This statement describes practice in mathematics assessment towards which all teachers should work. It is the basis for this paper — it provides the framework for the components of the AAMT position on assessing mathematics learning. The three organisers of the statement are key ideas identified from the AAMT *Standards*.

**Students' learning of mathematics should be assessed in ways that:**

- are appropriate;
- are fair and inclusive; and
- inform learning and action.

Under each heading, the paper outlines the AAMT's expectations for teachers and assessment programs of education authorities.

Assessment in mathematics is regularly identified by teachers and schools as a major priority for teacher professional learning programs. This statement identifies the complexity of the task of assessing students' mathematics learning, and the importance of doing it well. Hence the statement will assist in the development of programs of professional learning that enhance teachers' approaches to assessment in mathematics.

# Practices for assessing students' mathematics learning should be **APPROPRIATE**

The main purpose of schooling is student learning and development, and this should be supported by appropriate assessment. Assessment is undertaken to provide information about students' learning and/or their attitudes to learning and doing mathematics. This information allows teachers to make informed professional judgements about a range of matters including students' progress and achievement, students' learning and attitudes needing further attention, future teaching actions and to contribute to their reflection on their work as teachers. Teachers need to ask and satisfactorily answer the question "Will this assessment give me information about students' learning that adds significantly to what I already know; or add significantly to my current confidence in my judgements about students' learning?" Assessment information is used by teachers to give feedback to students, and by education authorities to provide public accountability for themselves, and for credentialing of individual students.

### Teachers should:

#### assess by matching the purpose to the information required

Teachers should consciously plan appropriate assessment practices as well as plan and program a range of learning experiences.

Assessment for learning opportunities occur on a regular basis in classrooms. All learning tasks provide opportunities to assess students' current knowledge and to diagnose misconceptions, so that teachers are able to plan subsequent learning experiences. Open-ended tasks are a useful tool for this purpose as they can provide information about a broader range of aspects of students' learning than is possible through more narrowly constrained tasks.

Assessment of learning should be used at key stages of schooling to provide feedback to students and parents about student's learning. It also serves an important purpose to inform other teachers about the learning outcomes for each student as they progress from one year to another. Frequently pen-and-paper tests are used for this purpose. Interviews are an appropriate alternative. Other strategies, such as extended investigations and written explanations (or verbalisation) of thinking, are useful since they provide richer information about student thinking and attitudes. Such alternatives are more appropriate for assessing progress with respect to working mathematically.

#### assess the full range of learning goals by using a range of strategies

Obtaining information about aspects of students' learning by using different strategies helps maximise the opportunities for students to show what they know and can do. Teachers can triangulate information from different sources to increase their confidence in their judgments about students' learning and progress. Using a range of strategies enables teachers to assess different components of mathematical learning and students' development as mathematicians. Consistency in teacher judgment is supported by teacher collaboration.

The "maths test" is perhaps the public's enduring memory of school mathematics. Tests can be an effective means for teachers to find out about a student's knowledge, skills and routine application. Today's mathematics curriculum goals go beyond these components to include thinking and working mathematically, effective communication of

mathematical ideas and findings, mathematical modelling among others. This breadth of expectations requires the use of assessment tasks and strategies that enable students to demonstrate the full extent of their learning, including application, thinking, reasoning and problem solving — mathematics tests need to be used in conjunction with other forms of assessment.

Solving problems and investigating mathematical ideas usually require more time and students frequently benefit by working with peers. Such experiences need to be assessed using different strategies such as written reports and group presentations, teacher observation, and discussion with students.

### Education authorities' assessment should:

#### match the published curriculum or syllabus

Assessment events (tests, examinations, etc.) conducted by education authorities should be based on skills and knowledge students are expected to have had opportunities to learn. These events should include and expect appropriate use of technologies as required in the curriculum documentation about the use of those technologies for learning and doing mathematics.

#### match the published purpose(s) of the assessment program

Legitimate purposes can be for individual credentialing, diagnostic purposes and informing school/system (i.e., public) accountability measures. The purpose of the assessment program needs to be clear, and clearly stated, to enable public evaluation and critique of the appropriateness of the actual instruments and items used in the assessment program. The layout and language of reports to students and their parents, in particular, need to be designed with the audiences in mind. They should be as easily understood as possible.

#### use instruments that are economical

Large-scale assessment programs are expensive. Funds applied to these should be proportional to the benefits from the program to the students, teachers, parents, schools and the education authorities themselves. Excessive public expenditure on assessment programs cannot be justified in the context of limited overall funding for education.

# Assessment of students' mathematics should be **FAIR AND INCLUSIVE**

No assessment of student learning is value-free. Whether it is a pencil and paper skills test or a more open-ended task, each assessment task is effectively a contract between the teacher and the student that communicates and reflects what is valued in the mathematics classroom.

### Teachers should:

#### **involve students in the processes for assessing their learning**

Teachers should ensure that students are aware of the criteria for success in their learning, and be able to articulate these. Students should be taught how to use assessment criteria in evaluating their own mathematical work, and be encouraged to do so. There should be opportunities for students (individuals and groups) to negotiate aspects of their assessment, including selecting and designing tasks and the criteria to be used in judging performance. Self- and peer-assessment are readily accessible strategies for teachers to begin the process of involving students in their assessment.

#### **use assessment strategies and tasks that are as fair as possible to boys and girls, and inclusive of students from a variety of backgrounds**

Students' backgrounds are critically important in determining how they access and interpret different assessment tasks. Thus teachers need to ensure that assessments are culturally and gender inclusive, and that they include open-ended tasks that give students the opportunity to show what they know and can do, rather than what they do not know.

Circumstances such as physical and learning impairments as well as transient factors such as illness, times of family and personal turmoil, etc., can all have an impact on a student's capacity to show what they know — teachers need to be mindful of these factors and ensure that students are not disadvantaged by factors beyond their control.

#### **assess in ways that are clear and transparent to students**

Teachers should ensure students are clear about the purposes of the assessment, what they need to do to be successful and what feedback or further action will flow from the assessment. Historically, many students have experienced anxiety as a result of mathematics assessment (i.e., the “maths test”). When teachers use assessment practices that are clear to the students, potential anxiety about the assessment task is significantly diminished.

#### **be fair and inclusive when making judgements**

Sometimes students may be unfairly judged because of a teacher's prior knowledge of the student or assessment of their work and responses. Teachers need to be open to new information and interpretations that alternate assessment activities may afford. They should ensure that they develop criteria and assessment rubrics that are inclusive and apply these criteria consistently when making judgements about students' learning. Collaborating with other teachers, for example by using moderation procedures, can assist teachers to ensure that the design of criteria and their use when making judgements does not disadvantage individual students and groups of students.

#### **assess through planned means and through opportunities that arise in their work with students**

Teachers should establish a timely program of “events” for assessing student learning. They should also retain a capacity to capture and act on information on student learning that emerges spontaneously from students' work, and from their observations and interactions with students. The emphasis should be on the quality of information about students' learning that is obtained, not the quantity.

#### **ensure students are familiar with the genres of items used in their own assessment programs and in those of education authorities**

Assessment items should mirror the learning strategies of the mathematics classroom, rather than asking students to do something with which they are unfamiliar. This does not mean that students cannot be expected to solve new or unfamiliar problems, but that it should not come as a surprise when they are expected to do so. Formal assessment programs used by education authorities use genres of assessment items that may be unfamiliar to some students through their everyday learning of mathematics in the classroom. Often high stakes assessment programs convey expectations through key terms. Teachers at all levels of schooling need to ensure that students who are required to take part in formal assessment programs are familiar with what might be expected of them in terms of responding to the items they will encounter. This is not about “teaching to the test” — it is making sure all students can access the test and show what they know and can do in that context.

## Education authorities' assessment should:

### be fair to students

Many of the expectations about fairness in assessment for teachers are also applicable to the programs of education authorities. Minimising gender bias, and bias related to students' social and cultural backgrounds are critical areas for these programs to address, and to be seen to be addressing. The contexts used in assessment items should be accessible to students through their own "local" familiarity, or as a result of explicit teaching that ensures appropriate familiarity. In addition, programs should also take account of the likely literacy levels of the students and provide access to the mathematics of the tasks without having unrealistic expectations of the students' literacy levels. High stakes assessments must assess within the course and relevant syllabus statements, and be seen to be so.

### take account of students' personal circumstances as appropriate

High stakes assessment systems, in particular, need to provide accommodations that ensure access for students with physical disabilities or medical conditions that would otherwise be a disadvantage to them in demonstrating their knowledge and skills.

# Assessment of students' mathematics should **INFORM LEARNING AND ACTION**

As assessment should lead to actions, teachers should ask themselves “How will this assessment promote and inform subsequent action by me, by other teachers, by my students and by parents or other members of the community?”  
(Clarke, 2005).

### Teachers should:

**reflect on assessment information and use it to plan students' learning experiences**

Teachers should use a range of strategies that support the principle of taking constructive, learning-oriented action on assessment information. These strategies include open-ended and contextualised tasks, student portfolios, student self-assessment, the classroom negotiation of assessment criteria, and student-constructed test items. They should analyse and reflect on the information they obtain from assessment of students' learning in their short, medium and long term planning for further learning. The implications for planning can be significant. It may be necessary to revisit the mathematics involved if many or most of the students showed that they did not 'get it'; normally this revisiting will require teachers to take a different approach; if substantial and persistent evidence of wide variation in students' mathematical learning emerges then more targeted strategies may be needed.

Consideration of assessment information is the basis for seeking outside support for a student with a specific learning difficulty, or a particularly talented student.

**provide purposeful, learning-oriented feedback to students on their learning**

Teachers providing feedback to their students closes the loop of teaching, learning, assessment. Through providing good quality feedback teachers enable students to take responsibility for their learning and progress. Students need constructive feedback that can help them learn better — feedback needs to be specific so that students are able to take action. Feedback should also be shared with parents in ways that strengthen their capacity to actively support their child's learning.

**share assessment information with parents and colleagues as appropriate**

Teachers and schools should establish timely and effective processes and practices that ensure parents receive assessment information and teachers' professional judgements based on this information. Sharing between professionals needs to be in place at transition points within schooling (school-to-school or class-to-class) in particular, and should include specialists in learning difficulties or gifted education as appropriate in relation to particular students. The information provided to parents and professional colleagues should give a rich picture of the student's achievement and attitudes that goes well beyond what is communicated by a summary mark or grade (e.g., A to E).

### Education authorities' assessment should:

**make claims that can be related directly to what is actually assessed**

Mathematics learning is much more than that which can be assessed by pencil-and-paper; reports from these programs should acknowledge this limitation. The results of assessment programs that represent a single event (e.g., test) need to be viewed in that light, as representing students' performance at a particular time only.

**provide information that maximises opportunities for teachers to capitalise, in their teaching, on the assessment information gathered**

Longitudinal data about cohorts of students and data over time at a particular point of schooling can be very useful for teachers and schools to help improve their teaching of mathematics. Given the importance that is often placed on this information by teachers and schools as they plan for future student learning, it needs to be statistically legitimate, timely and report on findings to support analysis of students' learning needs by teachers.

**prohibit the publication of league tables of schools from their data**

School and student contexts are different — the extent of this variation means that nothing is gained from public comparisons of schools based on performance of students in one-off tests. Some of the measures involving 'like schools', and value added measures show much greater promise and should be further developed and analysed for their usefulness to teachers, schools and systems.

**engage teachers in the design and conduct of the program**

Having teachers involved as setters and markers, etc., provides a means for connecting the programs with the classroom. Teachers' input helps ensure better alignment with the curriculum, sensitivity to the realities of students' cultural and social backgrounds and so on. Involvement in assessment programs in these ways is also a good professional learning opportunity for teachers.

# References

Australian Association of Mathematics Teachers (2002; 2006). *Standards for Excellence in Teaching Mathematics in Australian Schools*. Adelaide: Author.

Clarke, D. (2005). *Assessment – Policy, practice, practicalities and praxis*. Paper presented at the biennial conference of the New Zealand Association of Mathematics Teachers.

Wiliam, D. (2005). Keeping learning on track: Formative assessment and the regulation of learning. In M. Coupland, J. Anderson & T. Spencer (Eds), *Making Mathematics Vital* (pp. 53–59). Adelaide: AAMT.

## The Australian Association of Mathematics Teachers Inc.

### Who is AAMT?

The Australian Association of Mathematics Teachers is the nation's premier organisation of mathematics educators. It aims to:

- support and enhance the work of teachers;
- promote the learning of mathematics; and
- represent and promote interests in mathematics education.

It is a federation of 12 associations of teachers of mathematics from all Australian states and territories and has over 5000 individual and institutional members.

### What does AAMT do?

- Publishes hard copy and electronic newsletters.
- Publishes three refereed journals which are available by subscription: Australian Primary Mathematics Classroom, The Australian Mathematics Teacher and Australian Senior Mathematics Journal. It also publishes other books and conference proceedings.
- Provides selected Australian and international mathematics resources through its mail order catalogue.
- Acts as a consultant and lobbyist on mathematics education issues.
- Facilitates the professional networking of teachers and educators.
- Conducts national conferences.
- Advocates the development and use of its "Standards for Excellence in Teaching Mathematics in Australian Schools".

### AAMT membership

There are many benefits to being an AAMT member, including substantial discounts on goods and services provided by the association. The AAMT does not have direct membership: you need to join your local association of teachers of mathematics, and then you are automatically a member of AAMT. More information about membership and a contact list of local associations is available on the AAMT website.

### Contact AAMT

The AAMT office in Adelaide manages the day to day affairs of the association. This office is normally open weekdays 9 am – 5 pm.

You can contact the AAMT by:

POST	GPO Box 1729, Adelaide SA 5001
STREET	80 Payneham Road, Stepney SA 5069
PHONE	(08) 8363 0288
FAX	(08) 8362 9288
EMAIL	office@aamt.edu.au
INTERNET	www.aamt.edu.au

