Mathematics A, B and C (2008)

Advice for teachers

Quality assuring your assessment program

August 2010

Queensland Government
Queensland Studies Authority

Queensland Studies Authority

Mathematics A, B and C (2008)

Advice for teachers

Quality assuring your assessment program

Compiled by the Queensland Studies Authority

August 2010

The QSA acknowledges the contribution of the Mathematics review panel chairs who assisted in the preparation of this document.

About this advice

This advice is intended to help teachers implement Mathematics A, B and C syllabuses in their school setting. It provides information about how schools and teachers should:

- use the syllabus to design and implement assessment programs and instruments
- quality assure assessment programs and instruments.

This information is intended to be used in conjunction with the Mathematics A, B and C senior syllabuses and other documents on the QSA website.

Introduction

In the Queensland system of externally moderated school-based assessment, teachers develop and implement assessment programs and instruments that cater for their school's unique context, resources and students.

It is important that schools' assessment programs meet the requirements of the relevant syllabus. This document describes the processes and tools that teachers and schools can use to ensure their Mathematics assessment program and instruments achieve syllabus requirements and reliably and validly assess learning experiences.

The diagram below shows the stages of planning teaching, learning and assessment. The flow chart on the following page shows the steps involved in developing and implementing assessment. The individual steps may vary, depending on the approaches taken for each instrument or task; however, all the processes described are essential in the development of a complete and effective assessment program.

This document will concentrate on the first three steps:

- understanding syllabus requirements
- developing the assessment program
- developing the assessment instruments.

Figure 1: Planning teaching, learning and assessment

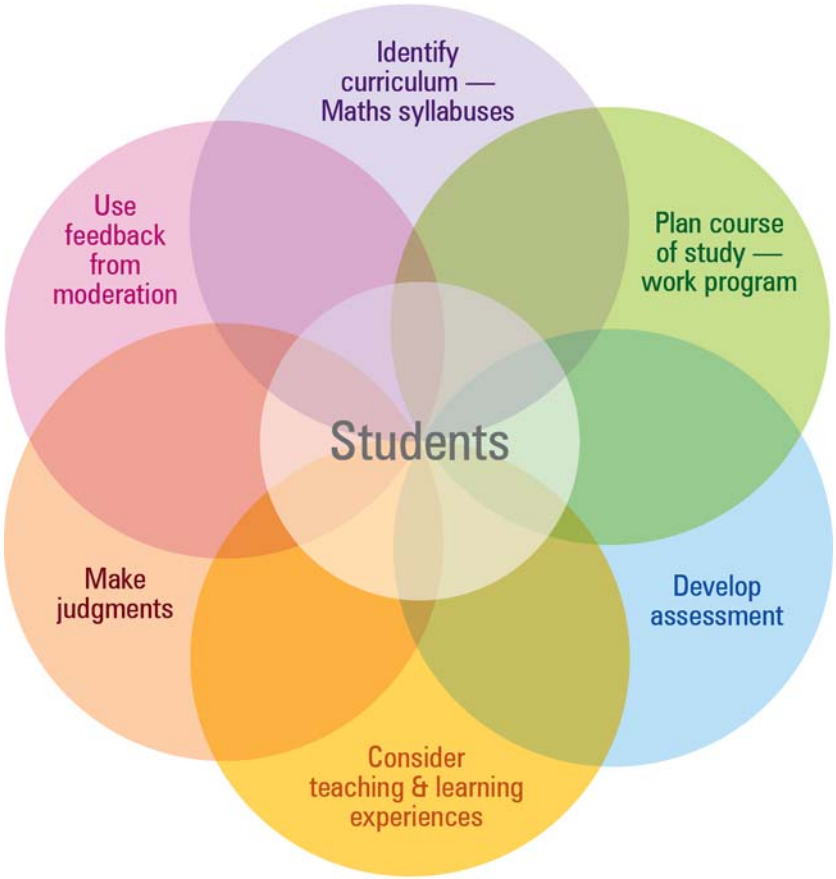
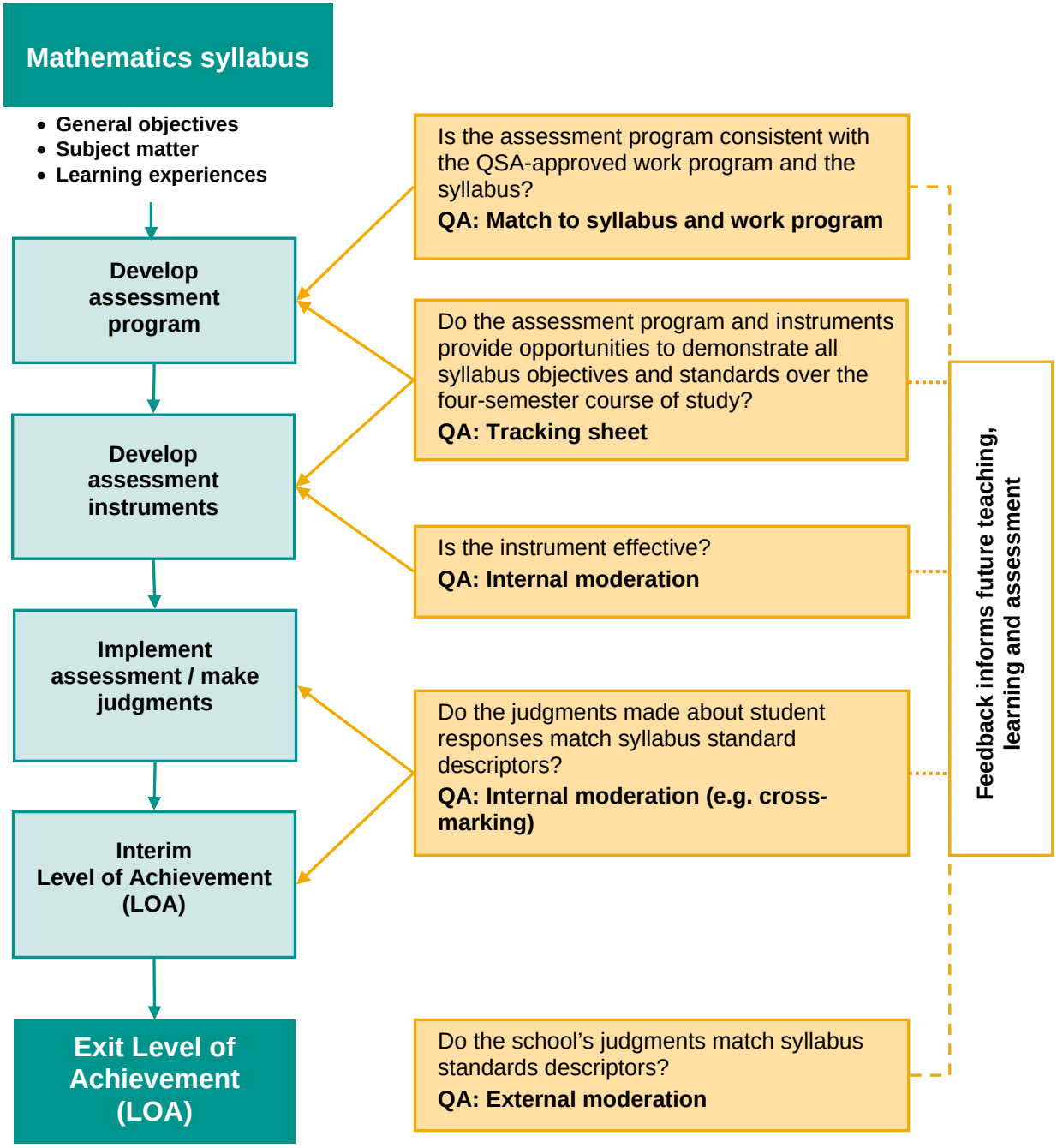


Figure 2: Developing and implementing assessment: processes and quality assurance



Understanding syllabus requirements

The Mathematics A, B and C syllabuses describe what schools are required to teach and what students should know and be able to do by the end of the four-semester course of study. They are the starting point for developing teaching, learning and assessment.

General objectives

The syllabus general objectives describe what will be demonstrated in student work by the successful completion of the course. The general objectives for Mathematics are:

- knowledge and procedures (KAPS)
- modelling and problem solving (MAPS)
- communication and justification (CAJ).

Topics

The syllabus lists topics, which can be core (mandatory) or elective. Each topic has a focus statement, subject matter and suggested learning experiences which, taken together, clarify the scope, depth and emphasis for the topic.

Textbooks and syllabuses

Although textbooks are invaluable resources, they cannot substitute for the syllabus.

Textbooks may explore topics beyond the subject matter required by the syllabus, and may miss significant mandated subject matter.

Any subject matter covered by a school that is additional to syllabus requirements and is taught at the expense of what is in the syllabus does not advantage students and may do the reverse.

Subject matter

The syllabus outlines the subject matter for each topic. Descriptions are not exhaustive and include qualifying statements of what is not included, e.g. “only simple examples of…” or “proof not required…” and comments on the context in which a topic may be delivered. Subject matter is described and explained in Section 5 of each syllabus, available from the QSA website <www.qsa.qld.edu.au>.

Learning experiences

Learning experiences are described in Section 5 of each of the syllabuses. Teachers may include learning experiences beyond those suggested. Such learning experiences are optional and at the teacher’s discretion.

Criteria and standards

The assessment program should provide opportunities for demonstration of the standards descriptors across the course of study. The standards descriptors are to be found in each of the relevant syllabus documents. Some of the key words used in the syllabus standards descriptors are explained in the Senior Mathematics Curriculum Glossary (PDF, 128 kB). Please note that these explanations are intended as a guide only, and do not replace information in the syllabuses. They should be used in conjunction with the syllabus and the syllabus glossary.

Developing the assessment program

Qualities of effective assessment programs

Effective assessment programs share a number of qualities. They:

- consider the strengths and experiences of teachers and students
- allow students to demonstrate the mandatory aspects of the syllabus, including:
  - general objectives (*knowledge and procedures*, *modelling and problems solving* and *communication and justification*)
  - core topics
- allow teachers to make judgments:
  - using the exit criteria and standards
  - incorporating the principles of a balanced course — application, technology, initiative and complexity (syllabus Section 3.3)
- meet syllabus requirements, including:
  - coverage of subject matter
  - verification folio requirements
  - underlying principles of exit assessment (syllabus Section 6.1)
- are quality assured using evaluative tools (e.g. *Quality Assuring Senior Assessment Instruments: A tools for schools*, available from the QSA website).

Designing Mathematics assessment programs

For an assessment program to meet syllabus requirements, assessment instruments must provide opportunities for a range of responses that demonstrate:

- coverage of all the general objectives
- each of the A–E standards descriptors.

It is not necessary that all aspects be included in each individual assessment task. However, across the summative assessment program, there should be sufficient opportunities available to allow students to demonstrate each of the aspects of the standards in each of the criteria.

In Mathematics, teachers can use the following strategies to ensure their program achieves appropriate coverage:

- Identify how KAPS, MAPS and CAJ will be covered.
- Include a range of questions from simple through to complex and from routine through to non-routine (allowing for the principles of a balanced course: application, technology, initiative and complexity; see syllabus Section 3.3). For example, within MAPS:
  - identify a set of assumptions
  - investigate what will happen when an assumption is changed.
- Scaffold items and tasks to ensure opportunities to demonstrate initiative.
- Evaluate possible responses to ensure the standards will match with the qualities of the student responses.

- Develop stimulus for questions which come from varied sources. For example, developing a question after exploring the global financial crisis. In this case, the stimulus is drawn from a real-life context.
- Map the coverage of the syllabus standards descriptors across an assessment program through the use of methods such as tracking sheets (see below).

Quality assurance: Tracking sheets

Tracking sheets can help ensure the assessment program provides opportunities for students to demonstrate each of the aspects of the standards in each of the criteria. For each assessment instrument, the tracking sheet records what opportunities are provided to demonstrate the syllabus standards descriptors. See the following pages for examples, and the QSA website for blank templates that schools can use and modify.

Figure 3: Example of a tracking sheet for Mathematics A

	Standard A	Standard B	Standard C	Standard D	Standard E
Criterion	**The student has had the opportunity to demonstrate:**				
Knowledge and procedures	accurate use of rules and formulas in simple through to complex situations 1 2 3 4 5 6	accurate use of rules and formulas in simple situations or use of rules and formulas in complex situations 1 2 3 4 5 6	use of rules and formulas in simple routine situations 1 2 3 4 5 6	use of given rules and formulas in simple rehearsed situations 1 2 3 4 5 6	attempted use of given rules and formulas in simple rehearsed situations 1 2 3 4 5 6
	application of simple through to complex sequences of mathematical procedures in routine and non-routine situations 1 2 3 4 5 6	application of simple sequences of mathematical procedures in non-routine situations or complex sequences in routine situations 1 2 3 4 5 6	application of simple sequences of mathematical procedures in routine situations 1 2 3 4 5 6	application of simple mathematical procedures in simple rehearsed situations 1 2 3 4 5 6	attempted use of simple mathematical procedures in simple rehearsed situations 1 2 3 4 5 6
	appropriate selection and accurate use of technology 1 2 3 4 5 6	appropriate selection and accurate use of technology 1 2 3 4 5 6	selection and use of technology 1 2 3 4 5	use of technology	attempted use of technology 1 2 3 4 5 6
Modelling and problem solving	use of strategies to model and solve problems in complex routine through to simple non-routine situations 1 2 3 4 5 6	use of strategies to model and solve problems in routine through to simple non-routine situations 1 2 3 4 5 6	use of familiar strategies for problem solving in simple routi situations 1 2 3 4 5		attempted use of given strategies for problem solving in well-rehearsed situations 1 2 3 4 5 6
	investigation of alternative solutions and/or procedures to complex routine through to simple non-routine problems 1 2 3 4 5 6	investigation of alternative solutions and/or procedures to routine problems 1 2 3 4 5 6			
	informed decisions based on mathematical reasoning in complex routine through to simple non-routine situations 1 2 3 4 5 6	informed decisions based on mathematical reasoning in routine situations 1 2 3 4 5 6	informed decisions based on mathematical reasoning in simple routine situations 1 2 3 4 5 6		
	reflection on the effectiveness of mathematical models including recognition of the strengths and limitations of the model 1 2 3 4 5 6	recognition of the strengths and limitations of the model in simple situations 1 2 3 4 5 6			

These tools allow schools to track coverage of syllabus standards descriptors across the assessment program — they can highlight where coverage of the syllabus standards descriptors has not been sufficient.

Adjustments can then be made to subsequent assessment instruments to ensure appropriate opportunities are offered to students.

	Standard A	Standard B	Standard C	Standard D	Standard E
Criterion	**The student has had the opportunity to demonstrate:**				
Communication and justification	accurate and appropriate use of mathematical terminology and conventions in simple non-routine through to complex routine situations 1 2 3 4 5 6	accurate and appropriate use of mathematical terminology and conventions in simple non-routine and/or complex routine situations 1 2 3 4 5 6	appropriate use of mathematical terminology and conventions in simple routine situations 1 2 3 4 5 6	use of mathematical terminology and conventions in simple rehearsed situations 1 2 3 4 5 6	use of mathematical terminology or conventions in simple rehearsed situations 1 2 3 4 5 6
	organisation and presentation of information in a variety of representations in simple non-routine through to complex routine situations 1 2 3 4 5 6	organisation and presentation of information in a variety of representations in simple non-routine and/or complex routine situations 1 2 3 4 5 6	organisation and presentation of information in a variety of representations in simple routine situations 1 2 3 4 5 6	presentation of information in simple rehearsed situations 1 2 3 4 5 6	
	analysis and translation of information displayed from one representation to another in complex routine situations 1 2 3 4 5 6	analysis and translation of information displayed from one representation to another in simple routine situations 1 2 3 4 5 6	translation of information displayed from one representation to another in simple routine situations 1 2 3 4 5 6		
	use of mathematical reasoning to develop logical sequences in simple non-routine through to complex routine situations using everyday and/or mathematical language 1 2 3 4 5 6	use of mathematical reasoning to develop logical sequences in simple non-routine and/or complex routine situations using everyday and/or mathematical language 1 2 3 4 5 6	development of logical sequences in simple routine situations using everyday and/or mathematical language 1 2 3 4 5 6		
	justification of the reasonableness of results obtained through technology or other means 1 2 3 4 5 6				

Figure 4: Another example of a tracking sheet for Mathematics A

Criterion	Standard	The student has had the opportunity to demonstrate:	Instruments					
Knowledge and procedures	A	accurate use of rules and formulas in simple through to complex situations	1	2	3	4	5	6
		application of simple through to complex sequences of mathematical procedures in routine and non-routine situations	1	2	3	4	5	6
		appropriate selection and accurate use of technology	1	2	3	4	5	6
	B	accurate use of rules and formulas in simple situations or use of rules and formulas in complex situations	1	2	3	4	5	6
		application of simple sequences of mathematical procedures in non-routine situations or c routine situations			3	4	5	6
		appropriate selection and accurate use of technology			3	4	5	6
	C	use of rules and formulas in simple routine situations			3	4	5	6
		application of simple sequences of mathematical procedures in routine situations	1	2	3	4	5	6
		selection and use of technology	1	2	3	4	5	6
	D	use of given rules and formulas in simple rehearsed situations	1	2	3	4	5	6
		application of simple mathematical procedures in simple rehearsed situations	1	2	3	4	5	6
		use of technology	1	2	3	4	5	6
	E	attempted use of given rules and formulas in simple rehearsed situations	1	2	3	4	5	6
		attempted use of simple mathematical procedures in simple rehearsed situations	1	2	3	4	5	6
		attempted use of technology	1	2	3	4	5	6
Modelling and problem solving	A	use of strategies to model and solve problems in complex routine through to simple non-routine situations	1	2	3	4	5	6
		investigation of alternative solutions and/or procedures to complex routine through to simple non-routine problems	1	2	3	4	5	6
		informed decisions based on mathematical reasoning in complex routine through to simple non-routine situations	1	2	3	4	5	6
		reflection on the effectiveness of mathematical models including recognition of the strengths and limitations of the model	1	2	3	4	5	6
	B	use of strategies to model and solve problems in routine through to simple non-routine situations	1	2	3	4	5	6
		investigation of alternative solutions and/or procedures to routine problems	1	2	3	4	5	6
		informed decisions based on mathematical reasoning in routine situations	1	2	3	4	5	6
		recognition of the strengths and limitations of the model in simple situations	1	2	3	4	5	6
	C	use of familiar strategies for problem solving in simple routine situations	1	2	3	4	5	6
		informed decisions based on mathematical reasoning in simple routine situations	1	2	3	4	5	6
	D	use of given strategies for problem solving in simple rehearsed situations	1	2	3	4	5	6
	E	attempted use of given strategies for problem solving in well-rehearsed situations	1	2	3	4	5	6

Tracking sheets can take various forms. Choose a format that suits your situation and needs.

Criterion	Standard	The student has had the opportunity to demonstrate:	Instruments					
Communication and justification	A	accurate and appropriate use of mathematical terminology and conventions in simple non-routine through to complex routine situations	1	2	3	4	5	6
		application of simple through to complex sequences of mathematical procedures in routine and non-routine situations	1	2	3	4	5	6
		analysis and translation of information displayed from one representation to another in complex routine situations	1	2	3	4	5	6
		use of mathematical reasoning to develop logical sequences in simple non-routine through to complex routine situations using everyday and/or mathematical language	1	2	3	4	5	6
		justification of the reasonableness of results obtained through technology or other means	1	2	3	4	5	6
	B	accurate and appropriate use of mathematical terminology and conventions in simple non-routine and/or complex routine situations	1	2	3	4	5	6
		organisation and presentation of information in a variety of representations in simple non-routine and/or complex routine situations	1	2	3	4	5	6
		analysis and translation of information displayed from one representation to another in simple routine situations	1	2	3	4	5	6
		use of mathematical reasoning to develop logical sequences in simple non-routine and/or complex routine situations using everyday and/or mathematical language	1	2	3	4	5	6
	C	appropriate use of mathematical terminology and conventions in simple routine situations	1	2	3	4	5	6
		organisation and presentation of information in a variety of representations in simple routine situations	1	2	3	4	5	6
		translation of information displayed from one representation to another in simple routine situations	1	2	3	4	5	6
		development of logical sequences in simple routine situations using everyday and/or mathematical language	1	2	3	4	5	6
	D	use of mathematical terminology and conventions in simple rehearsed situations	1	2	3	4	5	6
		presentation of information in simple rehearsed situations	1	2	3	4	5	6
	E	use of mathematical terminology or conventions in simple rehearsed situations	1	2	3	4	5	6

Developing assessment instruments

The table below may be used by schools to quality assure the design of assessment instruments.

Table 1: Steps in writing an assessment instrument

Steps	Description	☑
1	Consider the general objectives.	☐
2	Look at the work program for the subject matter that will be/was taught and decide which subject matter is to be assessed.	☐
3	Consider the instrument in the context of the assessment program (e.g. what has already been or will be assessed by other instruments). Refer to the syllabus to ensure coverage of the general objectives (a tracking sheet may be used for this purpose). Decide which of the syllabus objectives will be assessed and select the appropriate standards descriptors.	☐
4	Develop questions/items/tasks that allow students to demonstrate the selected aspects of the different standards.	☐
5	Develop an instrument-specific criteria sheet.	☐
6	Create an indicative response to ensure the standards descriptors chosen in step 3 will elicit the intended response.	☐
7	Work with other teachers/colleagues to review and evaluate assessment items, standards, timing, content and contexts (e.g. *Quality Assuring Senior Assessment Instruments: A tool for schools*, see below.)	☐
8	Repeat steps 3–7, if necessary, until assessment instrument effectively assesses the identified syllabus objectives.	☐

Quality assurance: Internal moderation

Schools are responsible for all internal moderation processes. These can be facilitated by a range of processes such as:

- designing school-based indicative responses
- applying indicative response to student responses both within classes and across classes
- ensuring judgments match the syllabus standards.

Schools may also use school-based or QSA-developed assessment products, such as:

- tracking sheets (see Figures 3 and 4 for examples)
- evaluative tools such as the QSA document *Quality Assuring Senior Assessment Instruments: A tools for schools* <www.qsa.qld.edu.au> and search for “tool for schools”.

More information

The QSA has developed a range of resources to support assessment in schools. These include sample assessment instruments with sample and indicative student responses, and the advice paper, *Designing Effective Assessment Instruments for Authority and Authority-registered Subjects.* These resources are available on the QSA website <www.qsa.qld.edu.au> Years 10-12 > Years 11-12 subjects > Mathematics.