Chapter 5 Assessment

This chapter discusses the roles of assessment in learning and teaching Mathematics, the principles that should guide assessment of the subject and the need for both formative and summative assessment. It also provides guidance on internal assessment and details of the public assessment of Mathematics. Finally, information is given on how standards are established and maintained and how results are reported with reference to these standards. General guidance on assessment can be found in the *Senior Secondary Curriculum Guide* (SSCG) (CDC, 2007).

5.1 The Roles of Assessment

Assessment is the practice of collecting evidence of student learning. It is a vital and integral part of classroom instruction, and serves several purposes and audiences.

First and foremost, it gives feedback to students, teachers, schools and parents on the effectiveness of teaching and on students' strengths and weaknesses in learning.

Second, it provides information to schools, school systems, government, tertiary institutions and employers to enable them to monitor standards and to facilitate selection decisions.

The most important role of assessment is in promoting learning and monitoring students' progress. However, in the senior secondary years, the more public roles of assessment for certification and selection come to the fore. Inevitably, these imply high-stake uses of assessment since the results are typically used to make critical decisions about individuals.

The Hong Kong Diploma of Secondary Education (HKDSE) provides a common end-of-school credential that gives access to university study, work, and further education and training. It summarises student performance in the four core subjects (including Mathematics) and in various elective subjects, including both discipline-oriented subjects and the new Applied Learning courses. It needs to be interpreted in conjunction with other information about students as shown in the Student Learning Profile.

5.2 Formative and Summative Assessment

It is useful to distinguish between the two main purposes of assessment, namely "assessment *for* learning" and "assessment *of* learning".

"Assessment *for* learning" is concerned with obtaining feedback on learning and teaching, and utilising this to make learning more effective and to introduce any necessary changes to teaching strategies. We refer to this kind of assessment as "formative assessment" because it is all about forming or shaping learning and teaching. Formative assessment should take place on a daily basis and typically involves close attention to small "chunks" of learning.

Formative assessment is designed to measure what students know and are learning as they go along, and the information gathered is used as feedback to plan the future learning and teaching activities in which students and teachers are to be engaged. It can be integrated into normal classroom activities and carried out in various ways including observation of students' performance during lessons, class discussion, oral presentations and project work, and examining the written work of students done in class or at home.

"Assessment *of* learning" is concerned with determining progress in learning, and is referred to as "summative" assessment, because it is all about summarising how much learning has taken place. Summative assessment is normally undertaken at the conclusion of a significant period of instruction (e.g. at the end of the year, or of a key stage of schooling) and reviews much larger "chunks" of learning.

In practice, a sharp distinction cannot always be made between formative and summative assessment, because the same assessment can in some circumstances serve both formative and summative purposes. Teachers can refer to the SSCG for further discussion of formative and summative assessment.

Formative assessment should be distinguished from continuous assessment. The former refers to the provision of feedback to improve learning and teaching based on formal or informal assessment of student performance, while the latter refers to the assessment of students' ongoing work, and may involve no provision of feedback that helps to promote better learning and teaching. For example, accumulating results in class tests carried out on a weekly basis, without giving students constructive feedback, may neither be effective formative assessment nor meaningful summative assessment.

There are good educational reasons why formative assessment should be given more attention and accorded a higher status than summative assessment, on which schools tended to place a greater emphasis in the past. There is research evidence on the beneficial effects of formative assessment, when used for refining instructional decision-making in teaching, and generating feedback to improve learning. For this reason, the CDC report *Learning to Learn – The Way Forward in Curriculum Development* (CDC, 2001) recommended that there should be a change in assessment practices, with schools placing due emphasis on formative assessment to make assessment *for* learning an integral part of classroom teaching.

It is recognised, however, that the primary purpose of public assessment, which includes both public examinations and moderated School-based Assessment (SBA), is to provide summative assessments of the learning of each student. While it is desirable that students are exposed to SBA tasks in a low-stakes context and that they benefit from practice and experience with such tasks for formative assessment purposes without penalty, similar tasks will need to be administered subsequently as part of the public assessment process to generate marks to summarise the learning of students (i.e. for summative assessment purposes).

Another distinction to be made is between internal assessment and public assessment. Internal assessment refers to the assessment practices that teachers and schools employ as part of the ongoing learning and teaching process. In contrast, public assessment refers to the assessment conducted as part of the assessment processes in place for all schools. Within the context of the HKDSE, this means both the public examinations and the moderated SBA conducted or supervised by the HKEAA. On balance, internal assessment should be more formative, whereas public assessment is more summative. Nevertheless, this need not be seen as a simple dichotomy. The inclusion of SBA in public assessment is an attempt to enhance formative assessment or assessment *for* learning within the context of the HKDSE.

5.3 Assessment Objectives

The assessment objectives for Mathematics are closely aligned with the curriculum framework and the broad learning outcomes presented in earlier chapters.

The assessment objectives of the Compulsory Part are to test the candidates':

- knowledge of the mathematical facts, concepts, skills and principles presented in this guide;
- familiarity with and use of mathematical symbols;
- ability to use appropriate mathematical techniques for solving a variety of problems; and
- ability to communicate ideas and to present arguments mathematically.

The assessment objectives of Module 1 (Calculus and Statistics) are to test the candidates':

- understanding of the concepts, principles and methods in Calculus and Statistics presented in this guide; and
- ability to apply appropriate techniques in Calculus and Statistics for solving a variety of problems.

The assessment objectives of Module 2 (Algebra and Calculus) are to test the candidates':

- understanding of the concepts, principles and methods in Algebra and Calculus presented in this guide; and
- ability to apply appropriate techniques in Algebra and Calculus for solving a variety of problems.

5.4 Internal Assessment

This section presents the guiding principles that can be used as the basis for designing the internal assessment and some common assessment practices for Mathematics for use in schools. Some of these principles are common to both internal and public assessment.

5.4.1 Guiding Principles

Internal assessment practices should be aligned with curriculum planning, teaching progression, student abilities and local school contexts. The information collected will help to motivate, promote and monitor student learning, and will also help teachers to

find ways of promoting more effective learning and teaching.

(a) *Alignment with the learning objectives*

A range of assessment practices should be used to assess the achievement of different learning objectives. These include testing candidates' ability to: think critically and creatively; conceptualise, investigate and reason mathematically; use mathematics to formulate and solve problems in real-life as well as in mathematical contexts and other disciplines; and communicate with others and express their views clearly and logically in mathematical language. The weighting given to different areas in assessment should be discussed and agreed among teachers. The assessment purposes and criteria should also be made known to students so that they have a full understanding of what is expected of them.

(b) *Catering for the range of student ability*

Assessment practices incorporating different levels of difficulty and diverse modes should be used to cater for students with different aptitudes and abilities. This helps to ensure that the more able students are challenged to develop their full potential and the less able ones are encouraged to sustain their interest and succeed in learning.

(c) *Tracking progress over time*

As internal assessment should not be a one-off exercise, schools are encouraged to use practices that can track learning progress over time (e.g. portfolios). Assessment practices of this kind allow students to set their own incremental targets and manage their own pace of learning, which will have a positive impact on their commitment to learning.

(d) *Timely and encouraging feedback*

Teachers should provide timely and encouraging feedback through a variety of means, such as constructive verbal comments during classroom activities and written remarks on assignments. Such feedback helps students sustain their momentum in learning, and to identify their strengths and weaknesses.

(e) *Making reference to the school's context*

As learning is more meaningful when the content or process is linked to a setting which is familiar to students, schools are encouraged to design some assessment tasks that make reference to the school's own context (e.g. its location, relationship with the community, and mission).

(f) *Making reference to current progress in student learning*

Internal assessment tasks should be designed with reference to students' current progress, as this helps to overcome obstacles that may have a cumulative negative impact on learning. Teachers should be mindful in particular of concepts and skills which form the basis for further development in learning.

(g) *Feedback from peers and from the students themselves*

In addition to giving feedback, teachers should also provide opportunities for peer assessment and self-assessment in student learning. The former enables students to learn among themselves, and the latter promotes reflective thinking which is vital for students' lifelong learning.

(h) *Appropriate use of assessment information to provide feedback*

Internal assessment provides a rich source of data for providing evidence-based feedback on learning in a formative manner.

5.4.2 Internal Assessment Practices

A range of assessment practices suited to Mathematics, such as tests, examinations, homework assignments, oral questioning, projects and exploratory tasks can be used to promote the attainment of the various learning outcomes. However, teachers should note that these practices should be an integral part of learning and teaching, not "add-on" activities.

Among the most widely used methods for internal assessment are tests, examinations and homework assignments:

Tests can be used for:

- determining what students have mastered and whether they are ready to proceed to the next teaching unit; and
- providing information to teachers so that they can make adjustments in their teaching.

Examinations can be used for:

- deciding whether students have progressed satisfactorily over a school term; and
- providing information about students' learning to other schools, educational institutions and employers.

Homework assignments can help:

- students to consolidate concepts in mathematics; and
- teachers to assess the performance of their students.

It is important to ensure that the number of homework assignments given is not excessive and that they are at a suitable level of difficulty and related appropriately to specific objectives. Also, they should not be confined to routine mathematical problems. When marking homework assignments, specific, clear, constructive and supportive comments, and suggestions for improvement, should be given as this helps students to identify their strengths and weaknesses and to know what is required for improvement.

Other possible practices are:

Oral questioning

Oral questioning need not be seen as a test of spoken language only – it can be helpful in other subjects also. It is a flexible approach which allows teachers to discuss matters in depth with able students, to tease out the meaning of obscure statements, and to find out the reasons for conclusions. Teachers are encouraged to try using oral assessment as it can be a valuable supplement to conventional assessment methods.

Projects

A project is any piece of assigned or mutually agreed work from which the constraints of lesson time have been largely removed. Asking students to carry out project work provides them with an opportunity to study a topic of interest in depth. Teachers may wish to draw the following steps in the process to their students' attention:

- Clarify the areas of interest
- Establish a framework for enquiry
- Find and select resource materials
- Organise data
- Present findings

Exploratory tasks

Exploratory tasks can be very useful in learning and teaching mathematics as a way of monitoring students' investigative abilities, higher-order skills and achievements on a continuing basis, and the scores on the tasks can be used to form part of the record of student progress. The use of appropriate tasks which are aligned with learning objectives can help to reduce the pressure of summative assessment; and the results on the tasks can also reflect the effectiveness of teaching and so lead teachers to make reasonable adjustments to their teaching strategies.

5.5 Public Assessment

5.5.1 Guiding Principles

Some principles guiding public assessment are outlined below for teachers' reference.

(a) *Alignment with the curriculum*

The outcomes that are assessed and examined through the HKDSE should be aligned with the aims, objectives and intended learning outcomes of the senior secondary curriculum. To enhance the validity of public assessment, the assessment procedures should address the range of valued learning outcomes, and not just those that are assessable through external written examinations.

(b) *Fairness, objectivity and reliability*

Students should be assessed in ways that are fair and are not biased against particular groups. A characteristic of fair assessment is that it is objective and under the control of an independent examining authority that is impartial and open to public scrutiny. Fairness also implies that assessments provide a reliable measure of each student's performance in a given subject, so that, if they were to be repeated, very similar results would be obtained.

(c) *Inclusiveness*

The Hong Kong Advanced Level Examination (HKALE) is designed for a relatively elite group of students, most of whom aspire to university study. However, the new assessments and examinations will accommodate the full spectrum of student aptitude and ability. The written papers in the public examination will contain multiple-choice and short questions which test candidates' basic knowledge of mathematics and long questions testing higher-order thinking skills. The SBA will provide room for a wide range of activities suited to the students in each school.

(d) *Standards-referencing*

The new system will be "standards-referenced", i.e. student performance will be matched against standards which indicate what students have to know and be able to do to merit a certain level of performance. For Mathematics, a set of written descriptors will be developed to provide information on the typical performance of candidates at each level.

(e) *Informativeness*

The new qualification and the associated assessment and examinations system should provide useful information to all parties. First, it should provide feedback to students on their performance and to teachers and schools on the quality of the teaching provided. Second, it should communicate to parents, tertiary institutions, employers and the public at large what it is that students know and are able to do, in terms of how their performance matches the standards. Third, it needs to facilitate selection decisions that are fair and defensible.

5.5.2 Assessment Design

Table 5.1 below outlines the assessment design for the public assessment for the Compulsory Part and Modules 1 and 2. This is still subject to continual refinement in the light of feedback. Full details will be provided in other supplementary documents, in particular the approved Regulations and Assessment Frameworks for the year of the examination.

Table 5.1 An outline of the assessment design

Compulsory Part

Component			Weighting	Duration
Public examination	Paper 1	Conventional questions	55%	2¼ hours
	Paper 2	Multiple-choice questions	30%	1¼ hours
School-based assessment (SBA)			15%	

Module 1 (Calculus and Statistics)

Component		Weighting	Duration
Public examination	Conventional questions	100%	2½ hours

Module 2 (Algebra and Calculus)

Component		Weighting	Duration
Public examination	Conventional questions	100%	2½ hours

From the table, the public assessment of the Compulsory Part will comprise two components: a public examination and SBA, with weightings of 85% and 15% respectively; while for the two modules in the Extended Part, there will only be a public examination, at least in the early stages. In the Compulsory Part, the SBA will be phased in as shown in Table 5.2 in section 5.5.4; and, based on this experience, consideration will be given to introducing an SBA component in the Extended Part at a later stage.

5.5.3 Public Examinations

Various kinds of items, including multiple-choice questions, short questions and long

questions, will be used to assess students' performance in a broad range of skills and abilities. Multiple-choice questions permit a more comprehensive coverage of the curriculum; short questions can be used to test basic knowledge and concepts. Longer questions aim to test candidates' higher-order skills. These item types will be similar to those adopted in the HKCE and HKAL examinations. When the curriculum content and the learning outcomes are finalised, specimen papers will be provided to schools to illustrate the format of the examination and the standards at which the questions are pitched.

The content to be examined is based on the learning objectives outlined in Chapter 2 of this guide. For both the Compulsory and Extended Parts, knowledge of the subject matter in the Foundation and Non-Foundation Parts of the Mathematics Curriculum (S1 – 3) is assumed, and, for the Extended Part, knowledge of the subject matter in the Compulsory Part is also assumed.

5.5.4 School-based Assessment (SBA)

In the context of public assessment, SBA refers to assessments administered in schools and marked by the students' own teachers. The primary rationale for SBA in Mathematics is to enhance the validity of the overall assessment and extend it to include testing candidates' ability to think critically and creatively, conceptualise, investigate and reason mathematically, communicate with others and express their views clearly and logically in mathematical language.

There are, however, some additional reasons for SBA. It reduces dependence on the results of public examinations, which may not always provide the most reliable indication of the actual abilities of candidates. Obtaining assessments based on student performance over an extended period of time and developed by those who know the students best – their subject teachers – provides a more *reliable* assessment of each student.

Another reason for SBA is to promote a *positive "backwash effect" on students and teachers*. SBA can serve to motivate students by requiring them to engage in meaningful activities that lead to useful feedback on their strengths and weaknesses. For teachers, it can reinforce curriculum aims and good teaching practice, and provide structure and significance to an activity they are in any case involved in on a daily basis, namely assessing their own students.

The Mathematics Curriculum (S4 – 6) aims to provide a balanced and comprehensive learning experience for students, through which they develop the necessary mathematical knowledge, skills, values and attitudes for future studies, the workplace and life in society. However, quite a number of the learning objectives in the curriculum, particularly those in the skills and attitude domains, cannot be readily assessed in external written examinations for various reasons (e.g. limited time, limited question types, the tools available, the wide ability range of candidates). Public examinations still have their strengths and merits and will continue to play a significant role in public assessment; but the introduction of an SBA component not only helps to improve validity and reliability, but also helps to integrate curriculum, teaching, learning and assessment.

In the Compulsory Part, students will be required to complete two assessment tasks: one in Secondary 5 and the other in Secondary 6. These tasks will be more extended in nature than the questions in traditional tests and examinations, and should provide opportunities for students to demonstrate their competence in the following skills and abilities, which are embodied in the curriculum objectives:

- applying mathematical knowledge to solve problems;
- reasoning mathematically;
- handling data and generating information; and
- using mathematical language to communicate ideas.

The assessment tasks can be in the form of written assignments or even practical tasks, and will be conducted mainly in school under teacher supervision. A wide variety of types of tasks can be adopted for assessment purposes, including, for instance, mathematical investigations and solving more sophisticated problems in real-life situations or with mathematics itself.

It is proposed that the required assessment tasks are:

- one task on mathematical investigation or problem-solving; and
- one task on data handling.

It should be noted that SBA is not an “add-on” element in the curriculum. The modes of SBA above are normal in-class and out-of-class activities suggested in the curriculum. The implementation of SBA will take into consideration the wide range of student abilities and efforts will be made to avoid unduly increasing the workload of both teachers and students.

To allow sufficient time for teachers to familiarise themselves with the administration of the SBA in the Compulsory Part, the following strategy for phasing it in will be adopted:

Table 5.2 The phasing in of SBA

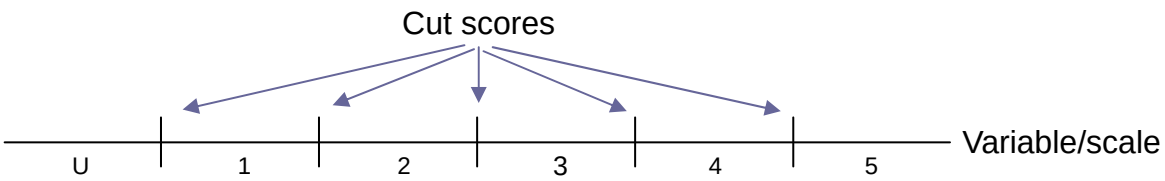
Year of examination	**Implementation of SBA**
2012	Schools are not required to submit SBA marks. Public examination results constitute 100% of the final subject results.
2013	Schools are not required to submit SBA marks. Public examination results constitute 100% of the final subject results.
2014	All schools have to submit SBA marks for feedback from the HKEAA on the outcomes of moderation. Public examination results constitute 100% of the final subject results.
2015	All schools have to submit SBA marks for feedback from the HKEAA on the outcomes of moderation. Public examination results constitute 100% of the final subject results.
Starting from 2016, all schools have to submit SBA marks contributing 15% to the final subject results.	

Detailed information on the requirements and implementation of the SBA and samples of assessment tasks will be provided to teachers by the HKEAA. Further details will be made known to schools in 2009 so that they can start practising SBA before it is formally implemented.

5.5.5 Standards and Reporting of Results

The HKDSE will make use of standards-referenced reporting of assessments. What this means is that candidates' levels of performance will be reported with reference to a set of standards as defined by cut scores on the variable or scale for a given subject. Standards referencing relates to the way in which results are reported and does not involve any changes in how teachers or examiners mark student work. The set of standards for a given subject can be represented diagrammatically as shown in Figure 5.1.

Figure 5.1 Defining levels of performance via cut scores on the variable or scale for a given subject



Within the context of the HKDSE there will be five cut scores, which will be used to distinguish five levels of performance (1–5), with 5 being the highest. A performance below the threshold cut score for Level 1 will be labelled as "Unclassified" (U).

For each of the five levels, a set of written descriptors will be developed that describe what the typical candidate performing at this level is able to do. The principle behind these descriptors is that they describe what typical candidates *can* do, not what they *cannot* do. In other words, they describe performance in positive rather than negative terms. These descriptors will necessarily represent "on-average" statements and may not apply precisely to individuals, whose performance within a subject may be variable and span two or more levels. Samples of students' work at various levels of attainment may be used to illustrate the standards expected of them. These samples, when used together with the level descriptors, will help to clarify the standards expected at the various levels of attainment.

In setting standards for the HKDSE, Levels 4 and 5 will be set with reference to the standards achieved by students awarded grades A–D in the HKALE. It needs to be stressed, however, that the intention is that the standards will remain constant over time – not the percentages awarded different levels, as these are free to vary in line with variations in overall student performance. Referencing Levels 4 and 5 to the standards associated with the old grades A–D is important for ensuring a degree of continuity with past practice, for facilitating tertiary selection and for maintaining international recognition. Secure monitoring tests will be used to ensure equivalence of standards over time.

The overall level awarded to each candidate will be made up of results in both the public examination and the SBA. SBA results for Mathematics will be statistically moderated to adjust for differences among schools in marking standards, while preserving the rank ordering of students as determined by the school.

To maintain current levels of discrimination for selection purposes, the Level 5 candidates with the best performance will have their results annotated with the symbols ** and the next top group with the symbol *. The Diploma itself will record the level awarded to each candidate. There will also be a Statement of Results which will in

addition provide level descriptors. The levels awarded to candidates in the Extended Part will be reported separately from the Compulsory Part.