Chapter 4 Assessment

Purposes of Assessment

It is generally agreed that assessment should promote students' learning and is an integral part of the learning–teaching cycle. The prime function of assessment has changed from providing a score or grade for ranking students to serving as an aid for learning. In general, assessment should be able to :

- provide reliable information that can be used to improve learning and teaching;
- provide feedback to students about their progress; and
- generate information to be used in reporting processes.

Clearly, assessment involves collecting, judging and interpreting information about students' performance. It can be formative or summative :

- Formative assessment is designed to measure what students know and are learning as they go along. The information collected is used as feedback to plan the future learning and teaching activities in which students and teachers are to be engaged. Formative assessment should be regular and ongoing and can be done in a number of ways including observations and discussions in class and examining students' written work done in class or at home.

- Summative assessment is designed to measure students' achievements and performance at certain intervals in time, such as at the end of a term or a school year. It is mainly used for providing a comprehensive and summary description of performance and progress in students' learning.

Both formative and summative assessments could achieve the said purposes. However, for diagnostic purpose aiming to identify students' strengths and weaknesses, it is imperative to make assessment on a regular basis. Therefore, formative assessment becomes more and more important in the learning and teaching process. There is nothing new as all teachers make regular assessments in the classes they teach. Most teachers would ask students questions, request them to attempt some questions either on the blackboard or at their seats,

hold discussions, organize class activities, etc. All these are formative assessments. What are highlighted here is that information should be collected regularly for making improvements to both learning and teaching and eventually raising standards. In general, assessment should not be considered as a separate add-on activity, but as an integral part of the learning and teaching cycle.

School Assessment

School assessment refers to all kinds of assessment activities that are administered in schools. It flexibly allows teachers to gather information to find out students' achievements related to the set objectives so as to make professional judgements about students' progress and to enhance the learning and teaching processes.

AL Pure Mathematics involves a wide range of learning objectives and processes. To gain a comprehensive understanding of student progress and achievement, evidence of student learning should be collected by a variety of assessment activities matching with the learning objectives. Both the processes (such as the strategies involved in solving a problem) and the products of learning (such as the solutions to problems) are important in mathematics learning. These should be reflected in the design of assessment. Different modes of assessment serve different purposes. Various assessment activities are needed to provide teachers with opportunities to collect, judge and interpret information about students' performance. Teachers should let students know how they will be assessed. Some common school assessment activities in AL Pure Mathematics include:

- **Class discussions or oral presentations**

  Class discussions and oral presentations are effective assessment activities. In the learning and teaching process, discussions, questioning and answering between the teacher and students (or among students) are often involved. Discussions in class not only enable teachers to discover what students understand about a particular topic, but also provide opportunities for students to present their views. They help foster their communication skills. Problems suitable for discussion include:

  - Can you describe what happens to the curve $y = \frac{x^3}{x^2 - 1}$ as x tends to infinity?

  - It is true that all convergent sequences are bounded. Is the converse true? In other words, are all bounded sequences convergent?

- Why $\int_a^b f(x)\,dx \geq \int_a^b g(x)\,dx$ if $f(x) \geq g(x)$ for all values in 〔a, b〕?

- What is the meaning of partial fractions? Can you express $\frac{x^4}{(x-k)(x^2+k^2)}$ into partial fractions?

- What is the definition of an asymptote of a curve? How many types of asymptotes are associated with curve sketching? What are their characteristics?

- Is the sequence $a_n = (-1)^n(1+\frac{1}{n})$ oscillatory? Why?

- Given that $f(x) = x^3$ and $f'(0) = 0$. Is it sufficient to conclude that $f(x)$ has a relative extremum at $x = 0$? Why?

- **Observations of students' performance in class**

Observations of students' performance in class are useful assessment activities. It is not easy to judge progress and achievement in the development of thinking abilities (e.g. high order thinking skills) and attitudes. However, through observations (particularly long time observations), teachers can develop an ever-clearer picture of students' performance. Some criteria may be used for assessing students during observations. These include:

- Are students able to answer questions raised by teacher and peers?
- Can students present their solutions properly?
- Can students explain how they have arrived at the solutions and what strategies they have employed?
- What is the degree of students' participation in class?
- Do students raise sensible questions?
- Do students raise questions actively?
- What are students attitudes, e.g. independence, cooperation and perseverance to work?

- **Classwork and homework**

Assignments such as classwork and homework are widely used in the learning and teaching processes and can help students consolidate concepts in mathematics and

teachers assess the performance of their students. It is important to give appropriate amount of assignments and to ensure that they are at a suitable level of difficulty. Each assignment should be appropriately related to specific objectives. It is inappropriate, for example, to give students an assignment which involves extremely difficult skills in evaluating an integral while the aim is to assess the application of definite integration in finding plane areas. Moreover, assignments should not be confined to routine mathematical problems. They should include reading mathematics reference books, preparatory work for discussions in class, searching the Internet and looking up newspapers, magazines and journals, etc. When marking classwork/homework, specific, clear, constructive and supportive comments, feedback and suggestions for improvement should be given. This kind of information tells students about their strengths, weaknesses, progress and enables them to know what they should do next in order to improve.

- **Project work**

Project learning is a powerful learning and teaching strategy to promote self-directed and self-regulated learning. It is not intended to replace the learning and teaching of subject knowledge in a discipline but provides an alternative learning experience, which allows students to have more space for learning. It enables students to construct and connect knowledge, skills, values and attitudes through a variety of activities. It is also a good vehicle for facilitating students' development of generic skills[3]. Therefore, project is a very useful activity to assess students' performance. Teachers should note that projects can be done individually or in groups depending on their nature. Students' performance in project work may be assessed using the following criteria :

1. Comprehension of the project
2. Use of strategy and approach
3. Coverage, depth, accuracy of content
4. Presentation and communication
5. Attitude

3 The 9 essential generic skills identified are collaboration skills, communication skills, creativity, critical thinking skills, information technology skills, numeracy skills, problem solving skills, self management skills and study skills.

- **Short quizzes**

  Short quizzes can be conducted during a lesson as a revision. Students' responses often provide clues to their misunderstanding, levels of understanding, strengths, weaknesses, abilities, etc. Teachers can pose one or two simple problems on the topics previously taught (e.g. students are asked to evaluate a determinant with two rows identical or proportional) and assess from students' solutions their understanding on that topic (e.g. students are asked to evaluate a determinant by elementary row operations with all steps clearly shown). Short quizzes can sometimes be done in oral form.

- **Investigations**

  Investigation is one type of class activity. When students conduct investigations, teachers can look at students' problem-solving skills and, if the activities are conducted in groups, collaboration skills. Students' performance during investigations can be assessed through observations. Criteria on assessing investigations include:

  1. Comprehension of the problem
  2. Use of strategies and approaches
  3. Degree of participation and attitude

- **Tests and examinations**

  Tests and examinations have been widely employed as the major methods of assessment within schools. Nevertheless, teachers should pay attention to the following points when setting test/examination papers:

  1. The coverage in the paper should be proper and the item formats should be diversified.
  2. Each item should have a clear assessment objective or objectives. Teachers should constantly refer to the curriculum aims and objectives when setting test and examination items.
  3. Teachers should avoid testing only basic information recall and should try to construct items that assess the understanding of concepts, problem solving skills and high order thinking skills.
  4. The item difficulty level should reflect students' abilities.
  5. The language used in the paper should be simple and clear.

Before setting a test/examination paper, teachers should prepare a table of specifications and a marking scheme. In the table of specifications, marks allocation on the learning units being assessed should be clearly shown. Appropriate amount of marks should be allocated so as to reflect the aims and focus of the paper and to ensure the proper coverage of the topics being assessed. The paper should embrace various types of items, like short items, long items, structured items, etc. to assesss students' knowledge in various aspects of mathematics. Open-ended questions should also be included to assess students' thinking abilities including communicating and reasoning skills in AL Pure Mathematics. Open-ended questions focus on students' understanding and their ability to reason and apply knowledge in less routine contexts. Such questions can reflect more clearly the levels of student achievement. In general, open-ended questions require complex thinking and may yield multiple solutions. They require teachers to interpret and use multiple criteria in evaluating students' responses. Instead of simple memorization, they require students to construct their own responses (e.g. construct a sequence which converges to zero; construct a non-zero 3×3 matrix so that its inverse does not exist) and hence open a window to students' thinking and understanding. Such tasks become vehicles for communicating students' actual achievements to parents, teachers and students themselves.

In summary, a balanced assessment program including a variety of valid assessment activities is necessary for assessing achievement of the general objectives.

Feedback from Assessment

Feedback is a crucial element of assessment. Effective feedback should help students recognise their next step in the process of learning, how to carry it forward and provide encouragement. It should also help teachers recognise the gaps between students' actual and expected performances, identify students' strengths and areas for improvement, and improve teaching practice.

Teachers can use the information collected in the formative assessment activities to adjust teaching strategies, decide whether to include further consolidation activities or introduce enrichment topics in subsequent day-to-day teaching.

Feedback from summative assessment activities can provide information for students to plan their subsequent phase of study and teachers to plan the teaching sequence, and to adjust the

breath and depth of the curriculum for the subsequent term or year. This information can be very useful for schools to adjust the aims and strategies of the school-based curriculum of AL Pure Mathematics.

Public Assessment

Hong Kong has relied on written tests and examinations as major methods of public assessment as well as within schools. Written tests and examinations assess the products of learning such as memory, understanding of knowledge and concepts at a certain point in time. The Hong Kong Examinations and Assessment Authority (HKEAA) organizes the public assessment on AL Pure Mathematics curriculum to assess students' attainment on the aims and objectives. The public assessment serves to provide a testing of all students for the purposes of certification and selection. Moreover, the public assessment can also generate useful feedback on the effectiveness of learning and teaching of the subject through the subject report which provides students' overall performance in the examination.

The AL Pure Mathematics is the subject that has been designed for students intending to continue their studies in mathematics, engineering, science and technology. Students studying this subject are expected to have acquired mathematical knowledge at the Certificate of Education (CE) level in the subject Mathematics.

The assessment objective of the public examination is to test the understanding of basic mathematical concepts and their applications. The formats and details of the public examination can be found in the Handbook "Hong Kong Advanced Level Examination Regulations and Syllabuses" published annually by the Hong Kong Examinations and Assessment Authority.