Chapter 3 Learning and Teaching

Guiding Principles

In designing learning and teaching activities for AL Pure Mathematics, the following principles should be noted:

- Our main concern is to help students *learn to learn* rather than to deliver merely subject contents to students.
- All students can learn although at different paces.
- A learner-focused approach should be adopted.
- Information technology, when used appropriately, would increase the effectiveness of learning and teaching.

Suggested Learning and Teaching Strategies

Both the learning process and the end product in the learning of AL Pure Mathematics are important. Students should be allocated sufficient time to develop mathematical concepts, master problem solving skills and foster thinking abilities. It should be noted that students studying this curriculum are expected to have acquired mathematical knowledge at the Certificate of Education level (CE level), but previous knowledge of Additional Mathematics at the CE level is not necessary.

It should also be noted that no matter what emphasis of strategies is adopted, the teacher is the key person in classroom teaching. Liveliness and clear explanation of the teachers are students' main concern. Diversified learning and teaching activities are definitely beneficial to students. Applications of mathematical concepts to real-life situations also provide students motivation for learning AL Pure Mathematics.

In particular, attention should be paid to the following strategies when designing and preparing learning and teaching activities to facilitate students' learning.

<u>Catering for Learner Differences</u>

There is no hard and fast rule to address the problem of learner differences. However, the general approach of providing students with tasks or activities at different levels of difficulties seems viable. For less able students, tasks should be

relatively simple and fundamental in nature. For more able ones, tasks assigned should be challenging enough to cultivate and sustain their interest in learning. Alternatively, teachers could provide students with the same task, but vary the amount and style of supports, for example, giving more clues, breaking the more complicated problems into small parts for weaker students, etc.

The use of information technology (IT) could also provide another solution for teachers to cater for learner differences. For some topics, such as the limits of sequences and functions, sketching of curves, the use of appropriate software packages provides a simple, fast and accurate presentation which traditional teaching cannot fulfill. The use of IT in the learning of the subject is especially important to weaker students.

On the whole, no matter what strategy we are going to use to cater for learner differences, it should be able to maintain students' interest and confidence in learning mathematics.

Appropriate Use of Information Technology

For many years, lessons of AL Pure Mathematics have always been conducted with chalk and talk. Until recently, the wide spread use of computers provides enhancement for the learning and teaching in AL Pure Mathematics. Using IT in learning and teaching mathematics may bring about the following benefits:

(a) IT can enhance and extend mathematics learning experience, and encourage active student participation in exploratory and investigative activities.

(b) IT, when used as a tool, can support, supplement and extend learning and teaching activities, such as:
   - exercises and tutorials;
   - charting and graphical analysis;
   - simulation and modeling;
   - information retrieval and handling; and
   - data processing.

(c) IT may lead to new teaching strategies and practices in classrooms such as providing students with an interactive learning environment for contextual and situational learning.

IT in mathematics education could be considered as:

(i) a tool —— Teachers could use presentation software to present notes, geometry software to demonstrate graphs and models, zoom-in and zoom-out facilities in some graphing calculators or graph plotter software to sketch the graphs of different functions. For example, teachers could use *Excel* programs to illustrate the limits of sequences and functions.

(ii) a tutor —— Many mathematical software packages, in the form of CD-ROMs, could be served as a tutor to teach students mathematical concepts. These software packages illustrate mathematical concepts with texts, graphics and sound and contain graded exercises or tests. Students could use these software packages to revise the contents learnt in the classroom, remedy the weak areas or even learn new topics prior to teachers' teaching. They could further consolidate their learning with appropriate exercises chosen for their levels of difficulty at their own pace.

(iii) a tutee —— Teachers could develop their own educational programs using spreadsheets or other programming languages to suit their own teaching strategies. Students could also make use of software to explore properties of curves.

Both teachers and students of AL Pure Mathematics are expected to decide when to use the available technology both intelligently and critically. For example, students have to decide whether to use graphing software or French curve to draw graphs of parabolas, ellipses and hyperbolas. Teachers have to decide whether to use computers or other devices for demonstration and which software is more appropriate for the task.

Besides, varieties of group work to facilitate collaborative learning or investigative approach in learning with IT should also be considered. Classwork or homework should emphasize concept development and understanding instead of manipulating complicated expressions or symbols or just rote memorization of formulae.

Appropriate Use of Multifarious Teaching Resources

Besides IT, there are other teaching resources that teachers could make use of in planning and conducting the learning and teaching activities:

- Reference books
- Learning and teaching packages
- Audio-visual tapes
- Instruments and other equipment for drawing shapes and making models
- Resources in libraries / resource centres, etc.

It is unlikely that a book / a series of books will cover all the topics of AL Pure Mathematics at an appropriate depth of treatment. Teachers should therefore exercise their discretion in selecting suitable parts from different books and reference materials to teach.

Mathematical language is progressively abstract. Different learning theories point out the importance of providing students with rich experiences in manipulating concrete objects as a foundation for the symbolic development. Teachers could make use of teaching aids such as simulation models, graph boards, etc., to demonstrate the mathematical concepts and allow students to “play” around before asking students to “structure and apply” the concepts.

A large quantity of related materials for teachers’ reference can be obtained from libraries or various resource centres operated by the Education and Manpower Bureau, such as Curriculum Resources Centres.

Internet is another popular source for sharing and retrieving information. Gathering and selecting information from these sources would be major learning activities in the 21st century.

Finally, teachers should note that this document is only a guide rather than a rigid teaching plan that must be followed closely. They are encouraged to explore and discover their own teaching methods and schedules appropriate to the ability level of their students.