Chapter 6 Learning and Teaching Resources

This chapter discusses the importance of selecting and making effective use of learning and teaching resources, including textbooks, to enhance student learning. Schools need to select, adapt and, where appropriate, develop the relevant resources to support student learning.

6.1 Purpose and Function of Learning and Teaching Resources

Learning and teaching resources provide students with a basis for enriching their learning experiences. Effective use of resources will help students to: consolidate what they have learned; extend and construct knowledge for themselves; and develop the learning strategies, generic skills, values and attitudes they need – and thus lay a solid foundation for lifelong learning. The following are some examples of learning and teaching resources for Mathematics:

- textbooks and workbooks;
- reference books;
- newspapers/journals/periodicals/advertising leaflets/maps;
- audio-visual materials including ETV programmes;
- learning and teaching packages;
- software packages;
- resources on the Internet;
- community resources; and
- instruments and equipment for drawing shapes and making models.

All of these resources should be drawn upon to help students learn and broaden their learning experiences. The available resources need to be adapted to meet the different needs and abilities of students. In addition, where necessary, teachers are advised to develop their own learning and teaching materials for this purpose.

6.2 Guiding Principles

The basic considerations when selecting learning and teaching resources are as follows:

- They should be in line with the curriculum aims and contain core elements included in it.
- They should take students' prior knowledge and experience into consideration.
- They should present knowledge, concepts and ideas in an accurate and effective way.
- They should arouse students' interest and engage them actively in learning.
- They should be written in simple language to convey information clearly.
- They should provide access to knowledge, as well as scaffolds, to help students progress in their learning.
- They should cater for students' individual differences by providing a variety of learning activities at different levels of difficulty.
- Learning resources used in addition to textbooks should promote independent learning by complementing and extending what students have learned in class.
- They should facilitate discussion and further inquiry.

6.3 Types of Resources

6.3.1 Textbooks

In Hong Kong, textbooks are the main resources that Mathematics teachers use in deciding what and how to teach. Most of the instructional time is related to them in some way. Very often, they are the only resources to which all students have access during lessons, other than the teacher. Most problems for students' exercises and homework are taken from them. Textbooks, therefore, need to be selected with great care.

There is no single textbook which can suit the learning needs of all students in Hong Kong. In choosing textbooks, schools need to take into account the mathematical abilities, needs and interests of their students, as well as the quality of the books. In evaluating their suitability, teachers' comments on the extent to which the textbooks will need to be adapted should also be taken into consideration. It is also advisable to consult the Textbook Information and Recommended Textbook List provided on the EMB's homepage when selecting Mathematics textbooks for the Mathematics Curriculum (S4 – 6).

Noted below in Table 6.1 is a list of the key characteristics of good Mathematics textbooks.

Table 6.1 The main features of good Mathematics textbooks

Good Mathematics textbooks
A good Mathematics textbook should: • be in line with the curriculum aims and targets of the Mathematics Curriculum (S4 – 6); • help students develop the mathematics concepts, thinking abilities, generic skills, values and attitudes promoted in the curriculum; • stress the importance of the learning process as much as finding the correct answers; • provide opportunities for students to investigate tasks, discuss findings, make conjectures, test hypotheses and defend their solutions; • provide learning activities and task-oriented problems at the students' level of understanding to engage them in exploratory work and encourage high level thinking; • provide adequate examples and illustrations to help students understand the mathematical concepts and skills; • introduce concepts and skills logically in clear language; • allow flexibility for teachers in selecting materials that engage students in solving problems in real world; • be written in the language that is simple, clear, easy to understand and appropriate to students' level; and • be accurate in content and the use of mathematical terms and symbols.

Many textbooks contain some excellent ideas. However, they are limited by the linear presentation of ideas in print form, and so need to be adapted, as suggested in Table 6.2.

Table 6.2 Ways of using textbooks

Points to note to get the best out of Mathematics textbooks
Teachers should: • decide on the content and sequence of teaching based on their students' prior knowledge and abilities and their own view of progression – and not be bound by a textbook's content or sequence. This will involve them in exercising their professional judgment on whether all the materials in a textbook should be covered for their students; • make use of the activities and tasks provided in textbooks, so that students have opportunities to gain first-hand experience in exploring mathematics, as this can enhance their interest in the subject. However, once again, adjustments should be made to cope with the needs, interests and abilities of their students; • select suitable problems for classwork and homework. Students may be informed clearly about the difficulty levels of the problems assigned; • provide students with relevant supplementary materials if there are topics that are not fully explained; and • make use of any supporting resources provided (e.g. websites and computing programs) to enhance learning and teaching.

6.3.2 Reference Books

Reference books are valuable resources for both teachers and students. It is excellent if schools can afford to have a good collection of such books, but teachers and students can also make use of the resources in the community, for example the resources in the public libraries. The principles for selecting Mathematics reference books are much the same as for textbooks, but it is still worthwhile taking the following points about them into account:

- They are for complementing or further extending the content of textbooks, to enable students to make connections and gain a better understanding.

- The main concepts presented in them should be the same as those teachers expect students to learn.
- They should be challenging, but not frustrating or discouraging. They should promote students' interest and active involvement in learning.
- They should be used to encourage students to define problems or issues, conduct research, and draw conclusions that reflect their learning.

6.3.3 The Internet and Technologies

The emergence of the Internet has had a great impact on the learning and teaching of many subjects, including Mathematics. It is an invaluable source of information, and very often there are learning and teaching materials which can be downloaded for use. For example, there is freeware, such as *Winplot*, which requires no payment, and there are also trial versions of software packages, such as *Geometer's Sketchpad*, which allow free trials for a short period. The Internet also includes materials for self-directed learning which engage learners actively with mathematical ideas in an interactive environment. In addition, there are graphical and interactive tools through which students can acquire learning experiences that are very difficult to provide by traditional means.

In contrast to school libraries, whose collections cannot be accessed easily at home, the Internet provides many fascinating multimedia elements and hyperlinks that can be easily accessed. Moreover, it provides users with a variety of references such as articles and electronic journals. However, teachers must be aware of possible ethical, behavioural and privacy issues in using the Internet, and students should be alerted to the fact that not all information on the Internet is reliable.

The Internet also offers platforms for discussions. For instance, there are helpful mathematics websites, such as "Ask Dr Math" and "Ask NRICH", which allow students to discuss and ask questions freely. A list of the addresses of relevant websites for the learning and teaching of mathematics is available at

http:// www.emb.gov.hk/index.aspx?langno=1&nodeID=2403

Technology has not only vastly increased the amount of information available but has also dramatically changed the way that Mathematics is taught and learned. Teachers need to adopt new teaching approaches and use technologies strategically to promote learning and teaching. Technology also allows students to engage more easily in

exploration, make generalisations and take a more active role in the learning process. For example, when they explore the concept of functions, they may use graphing calculators or computer algebra systems to graph functions easily and quickly, thus leaving more time for them to explore suitable mathematical models to explain real-life phenomena or make discoveries and conjectures.

While technology has great potential for improving learning, there is also the possibility of wasting a great deal of time and resources. Teachers and students must ensure that they do not become immersed in technical details, forgetting the aims of learning and teaching mathematics. It should also be borne in mind that students vary in the extent to which they are comfortable in learning through IT.

6.3.4 Community Resources

Materials such as advertising leaflets, statistical reports and articles in the press can supply up-to-date information of interest to students. Various associations or organisations in the community also provide valuable seminars and forums to familiarise teachers and students with current issues in mathematics, e.g.

- The Hong Kong Association for Mathematics Education
  http://www.hkame.org.hk/

- The Hong Kong Association for Science and Mathematics Education
  http://www.hkasme.org/us.htm

- The Hong Kong Mathematical Society
  http://www.math.hkbu.edu.hk/hkms/hkms.html

- The Hong Kong Statistical Society
  http://www.hkss.org.hk

6.4 Use of Learning and Teaching Resources

With the greater emphasis on inquiry learning in Mathematics Education, teachers have to make use of a wide range of learning resources: textbooks; concrete materials such as counters, blocks and geometric models; audio-visual materials; written resources such

as magazines and journals; and IT resources such as dynamic geometry software and computer algebra systems. These resources must be used flexibly. However, it is important to be aware of the availability and limitations of different types of resources, and note that the ultimate goal of using them is to improve learning and teaching in Mathematics.

6.5 Resource Management

Proper use of resources can make learning and teaching more interesting and effective. It is advisable, therefore, to build up a suitable stock of resources, including teaching aids, reference books/materials, audio-visual aids and computer software packages.

If space is available, new resources and learning packages should be displayed for teachers' information and perusal. An up-to-date list of the teaching aids, audio-visual aids and computer software available in the school should be easily accessible for teachers, for example by putting it on the school Intranet.

Teachers should be encouraged to use resources which have been newly acquired or developed; and they should be invited to make suggestions for procurement. Small workshops, demonstrations or experience-sharing sessions can be conducted in school to provide teachers with a better understanding of the resources available. It is also helpful and cost-effective if teachers regularly share what they have developed (e.g. supplementary materials, illustrations, graphs, mathematical diagrams, as well as learning and teaching activities and strategies).

To assist schools in implementing the senior secondary curriculum, the EMB will continue to provide them with additional funding and allow flexibility in the use of resources to cater for their diverse needs. Schools are advised to refer to the relevant circulars issued by the EMB from time to time.

To help schools in managing curriculum change, the EMB has produced a curriculum resources directory at

http://www.emb.gov.hk/cr

which offers a central pool of ready-to-use learning and teaching resources and useful references developed by the EMB and other parties.