

Use of Information Technology in Teaching and Learning Secondary Mathematics

1. Introduction

The teaching and learning of mathematics are encountering dramatic changes since the rising up of information technology (IT) in the past decade. The introduction of electronic calculators in 1980's has brought about big influence on the teaching and learning of mathematics. In the 1990's, the popularity of computers and the Internet also acts as a catalyst to changing the mode of teaching and learning mathematics. Elements of IT have been incorporated into the teaching of mathematics and other different subjects.

2. Impact of Information Technology

The tools for teaching mathematics change from time to time. For years, blackboard has been the most important device in the teaching of mathematics. Nowadays, modern tools like computers, the Internet and graphing calculators, etc are used in classroom teaching. The popularity of these IT tools has a great impact on the teaching and learning of mathematics. There are different roles IT can play in mathematics teaching and learning and the areas of applications include data analysis, simulation, graphical presentation, symbolic manipulation, observing patterns and exploring theorems, etc. As IT is a powerful tool, the appropriate use of IT becomes one of the emphases in the mathematics curriculum. We should not bear the idea that IT is almighty and that it can solve all the problems. Teachers must decide when and how to use IT. Indeed the integration of IT into mathematics learning may generate a completely new kind of mathematics experiences for students that will have strong and long-term influences on their ways of understanding mathematical knowledge.

3. Appropriate Use of Information Technology

IT has become a fact of life and we have enjoyed many benefits since the advent of information technology. It is important for the teachers to make good use of IT to enhance teaching and learning while the students should master the technology to exchange and process information, to think and work logically and to become more adaptive to the dynamically changing environment.

To use IT in teaching and learning mathematics may bring about the following benefits¹:

- i. IT can enhance and extend mathematics learning experience, and encourage active student participation in exploratory and investigative activities.
- ii. IT, when used as a tool, can support, supplement and extend teaching and learning activities, such as:
 - exercises and tutorial,
 - charting and graphical analysis,
 - simulation and modeling,
 - information retrieval and handling, and
 - data processing.
- iii. It may lead to new teaching strategies and practices in classrooms such as providing students with an interactive environment for contextual and situational learning.

Teachers should pay attention to the situation that extensive use of IT tools in mathematics learning may lead to the de-emphasis of skills and trimming down of technicality. Therefore, care must be exercised in ensuring the necessary skills and content knowledge are learnt. Along with the activities of using IT, varieties of group work to facilitate collaborative learning or investigative approach in learning should also be considered. Class work or home assignment should emphasize upon concept development and understanding instead

¹ Curriculum Development Council (2000). Report on Holistic Review of the Mathematics Curriculum. HKSAR: The Printing Department.

of using IT to manipulate complicated expressions or symbols. It is also hoped that through these learning activities, students will also become habitual IT users in accomplishing learning tasks in schools and job-related tasks in their future workplace and hence, develop the attitude and capability for independent lifelong learning².

4. Categories of IT in This Teaching Package

IT, in a broad sense, could mean any technological device that processes information. Information, in this scope of interpretation, does not restrict to its literal or traditional meanings. It could also include data and graphics. IT tools in mathematics education include computer-assisted learning packages, computer application programmes, graphing calculators and the Internet, etc. The term IT may include a lot more tools as time grows. This teaching package includes some of the more popular IT tools. Teachers are free to adopt any other appropriate IT tools in teaching whenever necessary. The IT tools used in this teaching package are grouped into the following four categories:

(a) Dynamic Geometry Software

"Dynamic", in its own literal interpretation, means the power that produces movements. When it is applied to describe an interactive geometry software, it symbolizes the capacity of the software to create interactive geometric figures. The literal meaning of "dynamic" can be interpreted as geometric figures being produced and animated on the screen. It also illustrates the change of the graphics when one of the components is altered and the capacity to carry out measurements at a fast speed. Popular dynamic geometry software available in the market include *Cabri Geometry II* and *Geometer's Sketchpad*.

² Curriculum Development Council (2000). *Information Technology Learning Targets*. HKSAR: The Printing Department.

(b) Mathematical Software

Mathematical software has the features of drawing mathematical figures and graphs, calculating lengths, areas, angles, etc. at a fast speed and changing the shapes or measurements of figures instantaneously. These features allow more time for teachers' explanation and students' discussion in class, which are considered to be more important than spending time on paper-and-pencil calculations. Mathematical software is useful in helping students build up analytical concepts. For example, changing some of the coefficients in a linear graph could immediately generate a new graph; hence students can observe or even discover the relations between the coefficients and the shape of the graph. In this teaching package, the mathematical software used are *Winstats*, *Graphmatica* and *Poly*.

(c) Spreadsheet

Although spreadsheet programmes are originally designed for business applications, they are good teaching and learning tools in mathematics, especially in investigating number patterns, drawing statistical graphs and what-if type questions. The strengths of using spreadsheets in learning mathematics does not require advanced computer programming skills. Automatic display of numerical results, mathematical manipulation and graph drawing can be operated by simple commands. *Microsoft Excel* which is used in this teaching package contains a good range of built-in mathematics functions and graphing functions for mathematics learning. It is also readily available for use by teachers and students.

(d) The Internet

The Internet is an invaluable source of information. Mathematical software can be downloaded for teachers and students' use. Some of them are freeware which requires no payment from the users while some of them are trial versions which allow free trials for a specified period of time. Some programmes such as Java applets can be run directly on browsers. Teachers may find many programmes helpful and useful in the mathematics class.

5. Use of Exemplars in This Teaching Package

The exemplars in this teaching package are supplementary resource materials. Teachers should exercise their professional judgment as to how and when to use the exemplars. However, they should feel free to adapt the contents, adjust the level of difficulties and modify the worksheets in the exemplars to suit their needs. The following suggestions are for teachers' reference when using the exemplars:

- i. Teachers should bear in mind that IT is used in this teaching package as a tool for exploration. Teachers should avoid putting too much emphasis on the IT skills. Rather, the emphasis should be placed on the exploratory activities.
- ii. Before the lesson, teachers should first read the **Description of the Activity** and **Notes for Teachers** in the exemplars to have an idea of how to conduct the activity. The **Description of the Activity** in the exemplar is only a suggested approach for conducting the activity. Teachers could adjust the contents of the activity to suit their needs.
- iii. Before doing the exemplars, teachers should explain the **Operation Procedure** in the exemplar to the students. Together with the worksheets, the **Operation Procedure** may also be distributed to the students for their reference when using the computer software.
- iv. Steps in the **Operation Procedure** which are only suggestions do not mean to be exhaustive. Teachers could modify them to suit the needs of their students.
- v. The time for doing the exemplars depends on the abilities of the students and the availability of equipment. Teachers should plan carefully the time for the activities in each exemplar. The length and allocation of time could vary for different classes.

- vi. Exemplars focusing on exploratory activities should be completed by the students before they learn the theorems or rules concerned. For example, if the activity is on the exploration of Pythagoras' Theorem, students should not be taught of the theorem before the activity. Otherwise, the exploration activity is meaningless.
- vii. IT cannot replace formal proofs and it should be noted that IT only provides more cases for exploration.
- viii. In the case of providing computer files in some exemplars, teachers may load the files to the computer server in advance so that students will be free to make use of them in the lesson. Alternatively, in some situations, teachers have to prepare diskettes containing the files for students to use.
- ix. Effective use of IT depends on many different factors. Teachers should use IT intelligently and critically and bear in mind that there is no single strategy that works for all situations.
- x. Teachers should act professionally, sometimes as facilitators, to decide carefully how and when to use the available IT tools and choose the most appropriate ones to benefit their students.