

Chapter 5

Teaching Suggestions

I. Teaching Strategies

1. Teaching Methods

To help pupils work towards the learning targets, teachers are encouraged to adopt different teaching methods so that pupils are provided with adequate opportunities for learning both mathematical contents and the ways of learning and applying knowledge. The following methods can be adopted:

- Exposition by teachers
- Discussion between teachers and pupils, and among pupils themselves
- Practical activities
- Consolidation and practice of fundamental skills
- Problem solving activities
- Exploring activities

As a foundation for further study, more opportunities should be provided for pupils to observe, analyze, understand and judge events/information, and to develop their elementary thinking abilities. Teachers should also provide opportunities for pupils to use mathematical language, such as explaining results and briefly describing the methods used in solving or investigating problems in oral or written form or with the help of diagrams. However, teachers should avoid teaching by telling. Pupils should be allowed to explore and discover on their own as far as possible.

2. Learning Process

The teaching of mathematics should not only focus on obtaining accurate answers, but also on the process of learning and the use of mathematics. Teachers should guide pupils to express the mathematical relationships discovered and explain the process in mathematical language. Pupils should learn pleasurably through various learning activities and develop their imagination, creativity and thinking skills.

During the process of learning, teachers should provide enough time for pupils to inquire, communicate, reason, conceptualize, formulate and solve mathematical problems, appreciate the beauty of mathematics and apply mathematics in different contexts. Pupils should be able to understand thoroughly what they have learnt, master problem solving skills confidently and develop a positive learning attitude.

Inquiring involves discovering and constructing knowledge through questioning and verification. Through questioning, pupils are encouraged to further study problems with various strategies and find out different but possible conclusions for the problems.

Communicating involves receiving and exchanging ideas with the help of languages, symbols and charts. Listening, speaking, reading and writing are the main elements of communication. For example, explaining a result, briefly describing the methods used to solve or investigate problems and interpreting charts can help pupils develop their communication skill. Teachers are encouraged to provide opportunities for pupils to communicate mathematically. For example, after project work or group discussion, students are requested to present oral/written reports with the help of visual aids like models, diagrams, charts and graphs to enhance the effectiveness of communication.

Reasoning is to develop a set of reasonable or logical processes to deduce or induce conclusions. It is a fundamental ability for learning mathematics. Pupils should be allowed to learn mathematics through observation and applying deductive and inductive processes. Teachers can make use of real life examples to encourage pupils to engage in informal reasoning, making hypotheses and validating.

Conceptualizing involves organizing and reorganizing knowledge through perceiving and thinking about particular experiences so as to abstract patterns and ideas and make generalizations. Pupils need to access various types of related examples during the process of concept construction. Teachers are therefore encouraged to provide appropriate examples to help pupils understand the concepts involved. Moreover, most mathematical concepts are inter-related. For example, subtraction is linked with addition; multiplication is linked with addition and division; percentages are linked with fractions and decimals. In mathematics teaching, apart from the mastering of basic concepts, teachers should place due emphasis on helping pupils understand the linkage among concepts.

In problem solving, teachers should encourage pupils to use different strategies to arrive at reasonable conclusions. During the process of problem solving, teachers should guide pupils to:

- understand the problems;
- design and select appropriate methods to solve problems;
- carry out the plan; and
- examine the reasonableness of answers and seek other possible methods for tackling problems.

3. Catering for Learner Differences

One of the goals of basic education is to equip pupils with basic knowledge to solve problems. Owing to the fact that pupils differ in cognitive development, learning abilities, interest and background, teachers have to teach in accordance with pupils' abilities so as to enhance their competence in mathematics. Thus, teachers should select appropriate teaching contents and activities for an appropriate learning environment to meet the abilities and needs of pupils.

3.1 Designing Different Teaching Materials

Teachers should adopt a pupil-oriented approach in designing teaching materials because of the limited experiences of pupils. Examples used should link the knowledge and experiences mastered by pupils for easy understanding of new mathematical concepts and their inter-relationship. They should also facilitate the gradual development from concrete examples to abstract thinking. Teachers should identify the concepts and skills that pupils have not yet mastered, and then design appropriate teaching materials to facilitate their understanding. Teachers can also select enrichment topics that suit pupils' interest and abilities to enhance their interest and confidence in learning.

To cater for the needs of pupils with different abilities, teachers can grade teaching materials according to their abilities. Challenging activities can be designed for the more able pupils to explore and discover mathematical rules, so as to broaden their exposure, strengthen their thinking abilities and enhance their interest in learning mathematics. For the academically less able pupils, teaching materials, which are relatively easier and appropriate in quantity, can be designed to facilitate their understanding of the required basic knowledge and arouse their interest in learning. Teachers are encouraged to provide more clues, use real objects and diagrams, and simplify the complicated problems to help pupils understand and analyze abstract concepts and problems.

3.2 Forms of Activities

It is inevitable that pupils in a class differ in levels, needs and interest. Teachers can use whole class, group or individual teaching to cope with the requirements of the topics. A self-study corner can be established in the classroom for pupils to study at their own pace so as to foster their abilities of self-study.

II. Points to Note in the Teaching of Various Dimensions

1. Number Dimension

The Number Dimension mainly comprises concepts of numbers and operations. The process of teaching should be from concrete to abstract and from specific to general. For example, when whole numbers are taught, pupils should first learn how to count, read, and recognize numbers. Recording is done orally or by drawing. Then they learn to write numbers.

With the introduction of calculators, it is no longer necessary for teachers to spend too much time to train pupils in excessively intricate computational techniques. Hence, examples and exercises used in teaching should be limited to the use of small numbers. For example, the numbers involved in addition and subtraction should not exceed four digits. However, at various stages of operations, training in mental arithmetic, numerical estimation and quick methods should be strengthened. At Key Stage 2, for large numbers existing in real life situations, pupils should be allowed to use calculators, so that they can concentrate on learning the skills of problem solving. As for simple operations, pupils should be encouraged to engage in mental arithmetic or written calculation and be guided to judge under what circumstances calculators can be used. Apart from accurate and practised operations, teachers should encourage pupils to observe and explain the results obtained. Pupils should be trained to tackle a problem with alternative strategies and use reasonable and flexible methods to solve problems.

To cope with the development of new technologies, a unit called ‘Acquaintance with Modern Calculating Devices’ is included in the curriculum for pupils to learn the basic operations of calculators. After mastering the concepts and skills of the four rules of operations, pupils should be allowed to use calculators as tools for exploring patterns or problem solving so as to save time and alleviate pupils’ burden in performing complicated operations.

2. Shape & Space Dimension

When geometric shapes are taught, pupils should be allowed to touch and observe geometric shapes and to describe the shapes in mathematical language, for example, a quadrilateral is formed by straight lines. Pupils should also be allowed to learn and master the properties of shapes through intuitive and hands-on activities such as grouping, paper folding, shape cutting and dissecting, drawing and model making. Meanwhile, pupils should be enabled to understand quantitative relationships between shapes and objects in real life through thinking processes such as analysis, synthesis and comparison. This helps pupils build up a foundation for the study of area and volume. Teachers should let pupils learn the relationships between relative positions of shapes through observation, for example, in the picture below, the triangle is on the left of the rectangle. This can help develop pupils' spatial sense.



3. Measures Dimension

In this Dimension, teachers can help pupils understand different methods and units of measurement through 'direct comparison', and the use of 'improvised unit' and 'standard unit'. Pupils should be guided to recognize the need of using standard units and the approximation nature of measurement. Pupils have to understand that all results of measurement are approximations. Therefore in actual measurement they should be able to choose the correct unit and the number of decimal places to be rounded off.

Apart from time and money, pupils should use the metric system in activities and computation. A single unit should be used for record purposes. If necessary, traditional units currently in use can be introduced briefly, but there is no need to engage in computation exercises or their conversion. Teachers are encouraged to provide students with adequate activities for practical measurement. When measurement activities are carried out, pupils should be encouraged to estimate the results first before actual measurements. They should also be guided to select appropriate measuring tools and units. Pupils should be able to master the relationship between the units of measurement and engage in simple conversion in the metric system.

Pupils should be able to identify coins and notes, and the inter-relationship between them through activities and carry out their conversion. To avoid repetition and allow pupils to use the four basic operations in their daily life, the teaching of money and the four rules of operations could be integrated.

4. Data Handling Dimension

The learning targets of data handling are to enable pupils to understand the basic concepts and methods of statistics. Pupils have to master the methods of data collection and learn to read and make simple statistical graphs. Besides, pupils should recognize the characteristics of different statistical graphs through comparing and discussing the graphs. Pupils should then be able to choose appropriate statistical graphs for presentation according to the aim of the surveys and the characteristics of data.

As for statistical activities, teachers should select practical problems related to pupils' daily life. Activities should include simple data collection, data recording and processing, constructing frequency tables and making statistical graphs with pencil and paper, reading graphs, and analyzing and forecasting based on the data provided by statistical graphs. Pupils should be encouraged to collect data of other countries and regions through the Internet. Information technology should be fully utilized to process data quickly and express information graphically to facilitate pupils' in-depth discussion and assist them to accomplish projects. Through activities, pupils can apply statistical knowledge and methods to solve simple and practical problems, draw conclusions and forecast trends from regular patterns. This, in turns, will enhance their analytical skills. Pupils should be guided to estimate the average from simple statistical graphs.

5. Algebra Dimension

One of the aims of learning algebra is to enable pupils to solve problems with the help of equations apart from the arithmetical method. The use of equations can make the solving of practical problems that involve whole numbers, fractions, decimals and percentages easier, and enhances pupils' abilities in solving simple practical problems.

Pupils should be able to record with the help of algebraic symbols, formulate and solve simple equations which need no more than two steps of operation. Before pupils start learning how to formulate and solve equations, they should have mastered the relationships among various parts in addition, subtraction, multiplication and division so

that they can find the unknowns concerned according to the relationships. Equations should not involve operation of like terms. Use of large numbers in equations is not recommended. Only one unknown is allowed. Denominators with unknowns should not be involved. Teachers should ask pupils to examine their solutions after solving equations.

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Despite the fact that the mathematics curriculum for primary schools is classified into learning dimensions and learning units, it does not mean that the items are isolated. Mathematical concepts are inter-related and cover several dimensions. Concepts in a certain dimension are often related with that of other dimensions. For example, the methods of operation provided in the dimensions of 'Number' and 'Algebra' can be applicable to other dimensions of the curriculum. As a result, pupils should be guided to understand the inter-relationship among various dimensions when an individual dimension is taught.

III. Application of Information Technology

The methods of teaching and learning have changed with the society and the rapid development of information technology. Teachers' role changes from a transmitter of knowledge to a facilitator of learning. Therefore, they should make appropriate use of information technology such as calculators, computers and ETV to design diversified learning activities that are related to pupils' daily life. It should facilitate the learning of pupils and hence enhance their level of mathematics.

1. Application of Calculators

- The use of calculators aims at facilitating the learning of mathematics rather than replacing mental arithmetic and written calculation.
- Pupils can use calculators to explore number patterns, construct concepts and check different methods and results of problem solving.
- With the help of calculators, teachers can strengthen pupils' abilities in mental arithmetic and estimation, and judge the reasonableness of the results of calculation.
- Pupils should be guided to recognize the functions and limitations of calculators, so as to strengthen their abilities in exploring and solving problems.

2. Application of Computers

- Teachers should fully utilize various types of software to design diversified teaching activities for pupils to engage in self-study and collaborative study.
- Pupils can be guided to make use of appropriate software to explore number patterns, characteristics of shapes and the relationship between mathematical concepts so as to enrich pupils' knowledge in mathematics.
- Pupils should be guided to make use of appropriate software to draw shapes and statistical graphs, analyze data and compile reports.
- Pupils should be guided to use Internet or Intranet properly for collecting relevant mathematical information, enriching what they are learning and relating what they have learnt with real life.

3. Others

Apart from calculators and computers, teachers can also make full use of multimedia equipment like ETV, digital cameras, video cameras or tape recorders to design appropriate teaching materials for diversified mathematics teaching activities.

IV. Proposal on Teaching Plan

A teaching plan aims at facilitating the planning of teaching and learning activities in a school term, a school year or a Key Stage for teachers. The sequence of units in the exemplar does not represent the priority of teaching. Teachers should plan according to the needs of schools and pupils. The sequence and periods allotted to the units can be properly arranged and adjusted. Parts or all of the spare periods can be used for teaching the compulsory topics if necessary. It should be noted that teaching should progress along with pupils' cognitive development regardless of the methods used to plan for teaching. Special attention should be paid to related units, which should be taught from simple to complex. The more difficult part of the curriculum can only be taught when pupils have mastered the basic concepts. If a teaching plan is drafted for a Key Stage, teachers should ensure that the contents specified in the curriculum have been covered at the end of Key Stages 1 and 2.

The following items can be included in a teaching plan:

- targets of a dimension;
- objectives of learning units;
- teaching activities;
- expected teaching time;
- utilization of resources for teaching and learning; and
- tasks and exercises.

V. **Coordination of Teaching Materials and Other Resources**

Mathematical language is abstract in nature and pupils may find it difficult when learning mathematics. Therefore, teachers are encouraged to make use of different teaching materials to enhance pupils' interest in learning and understanding, so as to minimize the barriers to learning. In designing teaching materials, teachers can refer to suggestions and activities in textbooks and other reference materials. Proper adjustment according to the needs of schools and pupils should be made for developing effective and diversified teaching materials to help achieve the goals of teaching and enhance pupils' interest in learning.

In teaching mathematics, teachers should assign due quantity of tasks and exercises to pupils for consolidating their understanding of concepts, application of knowledge and mastering of skills. Tasks and exercises can also help teachers understand their teaching and make appropriate improvement. Diversified tasks and exercises should be designed to promote pupils' interest in learning and achieve different goals of teaching.

Apart from textbooks and ETV, teachers can also get access to other teaching resources through the following ways:

1. Campus and Surrounding Environment

Pupils, teachers, other staff within schools and even visitors are resources. They can provide plenty of different data. School facilities like computers with Internet and the surrounding environment can also provide information related to mathematics. The number of tables and chairs in a classroom, the shape and location of a building can be used for learning counting, shapes and direction respectively.

2. Purchase of Resource Materials

With enough funds, teachers can purchase different teaching materials as required, such as cubes, shapes, balances, measuring tools, calculators, computer software and reference materials.

3. Collection of Resource Materials

Teachers can collect information on their own or make proper arrangements to guide pupils to collect information from newspaper cuttings, pictures, real objects, data, magazines, posters and information from the Internet.

4. Self-production of Resources Materials

Teachers can make use of simple materials and computer software to make teaching materials on their own, such as shapes, statistical graphs, pictures, weights, measuring glasses, containers, models and worksheets. They can also work together to design teaching materials that suit the schools and the abilities of pupils and thereby establish a bank of teaching materials.

5. Education Resources Centre

To provide assistance to schools in teaching mathematics, the Education Department has established a number of education resource centres where various types of reference materials related to mathematics can be found. (For enquiries, please dial Education Department Hotlines.)