

## **Designing the mathematics curriculum in Malaysia: Making mathematics more meaningful.**

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**Abstract** The relatively brief history of mathematics education in Malaysia can be said to have developed in three distinct phases. In the first phase, the traditional approach, which emphasised mainly on basic skills (predominantly computational) was the focus of the national syllabus. In the late 70's, in consonance with the world-wide educational reform, the modern mathematics program (MMP) was introduced in schools. Understanding of basic concepts rather than attaining computational efficiency was the underlying theme of the syllabus. Modern topics such as set, matrix, vector, transformational geometry and statistics were introduced into the syllabus. Set, relations and modern geometry were seen as unifying across all topics. Finally, in the late 80's the mathematics curriculum was further revised. It is part of the national educational reform that saw the introduction of the national integrated curriculum (KBSM) both at the primary and secondary levels. This mathematics curriculum, which has undergone several minor changes periodically, is presently implemented in schools. The content of the syllabus does not differ significantly from the MMP, but emphasises on attaining the balance between understanding concepts and computational skills. The syllabus also emphasises on the importance of context in problem solving. These three syllabi, as in any other curricular development, can be seen to have evolved from changing perspectives on the content, psychological and pedagogical considerations in teaching and learning of mathematics, which considerably in the last four decades. In this paper, I will trace the development of the Malaysian mathematics curriculum from the psychological, content and pedagogical perspectives. I will argue that the development has in many ways attempted to make mathematics more meaningful, and thus more friendly to students both at the primary and secondary levels.

Within the last five decades, the Malaysian mathematics curriculum has undergone several significant changes. The relatively short history of the mathematics education can be said to have begun with the traditional mathematics emphasising mainly on basic skills (predominantly computational) in the primary grades. In the secondary school, a similar traditional approach in the teaching and learning of mathematics was used. Arithmetic, geometry and algebra were outlined separately in the syllabus with limited attempt to treat mathematics as an integrated subject (Asiaah Abu Samah, 1984). In the early 70's, the "Modern Mathematics Program" (MMP) was introduced to both the primary and secondary schools. The main aim of the program was to introduce some "modern topics" (such as simplified basics in set theory, statistics, vectors etc.) into the curriculum and at the same time to change the "traditional" approach in the teaching and learning of mathematics (Yeoh, Kanasabai & Ahmad, 1977). Beginning in the early 80's, as part of the nation-wide curriculum reform based on the National Philosophy of Education, the mathematics has undergone some significant changes. This curriculum is based on the vision that mathematics is a dynamic subject, coherently connected within itself and with almost all other areas of study, and that the main purpose of its study is to solve problems. In addition, mathematics has a rich historical background and that its discovery is as response to human problems.

### **Primary School Mathematics Curriculum**

The main goals of teaching mathematics at the primary level (ages 7 to 12 years) are to help students to acquire

- a) the basic skills in numeracy (computation limited to the decimal system)
- b) the ability to use these skills to solve problems
- c) the ability to estimate and make or calculate approximations and
- d) the ability to interpret graphs and arrangements of numerical data

More specifically, the curriculum is outlined so that students will be able to:

- a) Master the skills in writing numbers, counting and stating place value

- b) Acquire the basic skills in the four basic operations of adding subtracting, multiplying and dividing
- c) Acquire the ability to measure, weigh, state time and specify the face value of currency
- d) Identify and state the shapes of objects and able to know the properties of square, rectangles, triangles, cuboids, cylinders, spheres, cones and pyramids
- e) Solve problems involving numbers, measurement, weight, money, distance, space and time;
- f) Estimate and calculate approximations
- g) Record and read groups of data in the form of simple tables and graphs (Kementerian Pendidikan, 1988).

The syllabus specifically emphasised that the knowledge and skills on the operation of numbers should form the basis of the subject (Mok and Lee 1986). In the Special Guide for mathematics (Kementerian Pendidikan, 1988) the suggested teaching sequences for all the topics in the syllabus are outlined. The guidelines are divided into two parts comprising of the skills to be taught and suggested activities that can be used for teaching the appropriate skills.

All the units in the teaching guidebooks, printed by the Curriculum Development Centre, Ministry of Education, are structured in the same way. The suggested approach in the teaching of mathematics is to introduce the skills followed by activities that are real and concrete (Liew and Swetz, 1988). At the primary level, concrete experiences are emphasised. These concrete experiences are progressively expanded, as the students progress to higher levels, to include those that are commonly experienced by children at that level outside the classrooms. Problem solving, mainly word problems based on everyday experiences, are emphasised at the upper levels.

In summary, the aim of the primary grade mathematics is to enable the child to acquire mastery in the basic skills and that these skills are to be applied constantly to the child's real life experiences. Problem solving is emphasised throughout the curriculum. It is important to note, as stated earlier, that at the end of the sixth-year of schooling (age 12 years) are required to sit for a national examination in 4 basic subjects; mathematics, English, National Language and science. Although all students are allowed to continue their education at the secondary level regardless of the results they obtain, doing well in the examination can be used as passport for entry into selected schools. Obtaining good results in mathematics is of great importance ( see also Christiansen, Howson and Otte, 1986 for similar observation).

### **The secondary school mathematics curriculum**

The Integrated Secondary School Curriculum (KBSM) implemented in the mid 80's replaced the old curriculum and is considered to be the most extensive educational reform that the country has experienced in its history. Based on the National Educational Philosophy, the mathematics curriculum in KBSM is planned to provide students with experiences that may consists of the:

- a) integration of knowledge, values and language
- b) Integration of mathematics with other branches of knowledge
- c) Integration of mathematics with other branches of knowledge
- d) Integration of various topics in mathematics
- e) Integration of mathematics learned in the classrooms with those experiences outside the classrooms (Kementerian Pendidikan, 1989).

Related to the above, several aspects of mathematics are being given special emphasis in the mathematics curriculum. These aspects are:

- a) The balance between understanding of concepts and the mastery of basic skills

- b) The use of mathematics in real-life situations
- c) The development of problem solving skills
- d) The appreciation of history of mathematics, and
- e) Human societal and spiritual values inherent in the subject (see also Bishop, 1991)

The mathematics curriculum is “general” in nature and is structured as a continuum from Forms 1 to 5. The content of the syllabus is planned in three areas: **number, shape and relations**. These three areas are chosen based on the assumption that generally, in real life situations, a person encounters and thus needs understanding and the attainment of appropriate skills in the areas of:

- a) Numbers such as in counting and calculating
- b) Shapes, such as recognising and identifying the properties of shapes and their measurements
- c) Relationships, such as to be able to recognise and using patterns, rules, general principles, laws, associations and so on in numbers and shapes.

### **Goals and objectives of the mathematics curriculum**

The goals of the secondary school mathematics are to develop students’ abilities in logical, analytical, systematic and critical thinking; to develop students’ ability in problem solving and in applying the mathematical knowledge acquired so that they will be able to function effectively and responsibly in their daily lives. In addition the curriculum hopes, through various learning activities, that students will be able to appreciate the importance and beauty of mathematics.

Specific objectives of the secondary school curriculum are:

- a) to know and understand the concepts, definitions, rules, theorems, principles, related to space and the number system.
- b) to strengthen and expand the use of skills in addition, subtraction, multiplication and addition.
- 3) to master the basic skills (other than the four basic operations) such as
  - a) making approximations in numbers and measurement
  - b) ability to identify the shapes existing in the environment and at the same time recognise their properties
  - c) ability to measure and construct using the basic tools of mathematics
  - d) ability to gather, record, represent and interpret data
  - e) ability to identify and represent a relation mathematically
- a) mastering the skills in carrying out steps in certain algorithms and thus able to obtain certain results mathematically
- b) developing problem solving skills that involve various steps such as interpreting the problem, devising a plan, to carry out the plan and be able to check backwards the answers obtained
- c) ability to use the knowledge and skills in the management of one’s daily affairs effectively and in responsible ways, and
- d) attainment and appreciation in the process of doing certain mathematical tasks logically, systematically, heuristically and accurately (Kementerian Pendidikan, 1989)

### **Learning and teaching mathematics**

To achieve the aims of the curriculum, several factors are given priority. Students active involvement in the learning process is emphasised. The learning activities, the types of questions asked and the guides given to students should be geared towards upgrading the ability to think and assisting students learning through real life experiences. The simulated experiences should involve activities that encourage inquiry and provide opportunities for students to reach certain conclusions or solve problem independently. These experiences could also include the use of

mathematics in situations that are meaningful to students.

In planning the teaching of a topic, a mathematics teacher should consider how and when the following factors could be effectively used

- a) Activities that give meaningful learning experiences
- b) The use of mathematics in real life situations
- c) The effective use of problem solving skills
- d) Instilling of Malaysian societal values
- e) Imparting and appreciating the elements of history of mathematics

The teaching of mathematics should also provide means through which values, mathematical as well as human (see also Bishop, 1991) could also be inculcated to students. These are to be transmitted either directly or indirectly. For example, certain values can be transmitted through

- a) Co-operation as in co-operative learning activities.
- b) Analogies such as the importance of following certain procedures in mathematics as compared to the importance of following procedures in other areas of study
- c) Problems in suitable contexts such as the “value” of equity can be elucidated through lessons in fractions and so on

The elements of history are to be revealed and appreciated whenever appropriate. This can be transmitted through either a short story about famous mathematicians or a short historical account about the development of a symbol or concept. The problem solving skills should be taught directly and planned through the use of examples. The problems used should be relevant to students' experiences and appropriate with the mathematical maturity of the students.

The above teaching aspects can be included in any level of a mathematics level of a lesson,

- a) whether at the beginning of a topic
- b) when certain skills or concepts is being taught
- c) in certain exercises taken directly or adapted that are suitable with the students' backgrounds
- d) as an enrichment activity for deeper understanding of the subject

The mastery of various concepts together with reasoning and logical thinking should form the basis of all topics of all topics. For this purpose, all teachers are provided with “Further Elaboration of the Syllabus” (Kementerian Pendidikan, 1991) to guide teachers in sequencing the topics and learning activities. Following is an example extracted from the guideline:

Concept	Skills	Further elaboration
<p><b>STATISTICS</b></p> <p>a) The measure of dispersion Range as a measure of dispersion of a group and it refers to the difference between the highest and the lowest values for a given set of data</p>	<p>To determine the range for certain sets of data</p> <p>To determine;</p> <ul style="list-style-type: none"> <li>a) median</li> <li>b) first quartile</li> <li>c) third quartile</li> <li>d) the range between quartiles</li> </ul>	<p>The example chosen should be for both discrete as well continuous data</p>

b) First quartile is the ....		
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The use of everyday examples is not specifically stated in this guide, but has already being emphasised in other supporting materials. The teaching of concepts and skills should be taught in single units following its hierarchical order.

other considerations that are to be part of the teaching mathematics are that:

- a) teachers make the necessary connections for further students' understanding of concepts when appropriate
- b) exercises that are given to students should involve various situations. Soon after challenging students have grasp the meaning of certain skills, they should be guided to attempt problems or exercises that are challenging.

In the teaching of mathematics no fixed teaching strategy is recommend;. unlike the previous curriculum where teaching by the discovery method is encouraged. Teachers are encouraged to use varied teaching techniques and attempt to make the mathematics lesson meaningful, fun to learn and at the same time intellectual challenging.

In summary, the above outline describes the basic factors that are to be emphasised in the planning and implementation of mathematics lessons. It is also believed that the teacher is the most qualified person to decide or chose the most suitable or effective strategy. Teachers are also expected to follow the syllabus, using it as a guide, but is allowed to make the necessary adjustments or modifications depending upon the characteristics of students under his/her care.

The new curriculum, when compared to the previous ones, is more open in nature. It regards mathematics as forming a major part of one's daily life and that it can become a very powerful tool in solving problems experienced in our daily lives.

### **Summary: Other Salient features of the mathematics curriculum**

The approach taken in planning the mathematics curriculum in Malaysia is that the subject should be a friendly one and thus is planned or structured to meet the needs of students regardless of their abilities. This approach differs from the previous approach where mathematics is approached in a "specialised" manner. The curriculum is organised on three main strands; *numbers, space and connections*. These three bases are chosen based on the belief that in everyday living one is often faced with these elements in t he order listed. In addition, solving mathematical problems encountered in one's daily life becomes the overriding concern in the curriculum.

### **Mathematics as problem solving**

Although the definition of problem solving may differ to that of NCTM's (1992), it, nevertheless, becomes the significant elements to be emphasized in the teaching and learning of mathematics. Teachers are expected to intentionally teach students on the heuristics of problem solving. Although teachers are free to chose the strategy suitable for his/her students, they are encouraged to follow those recommended by Polya (1974). Teachers are also encourage to simulate mathematical problems based on their daily experiences. More specifically, teachers are expected to provide varied experiences through students can work individually or in groups in tackling mathematical problems. The curriculum places heavy emphases on relationships between mathematics and real life problems. Problem solving in real contexts are considered essential in helping students appreciate mathematics. In short, problem solving becomes the focus in the curriculum.

### **Mathematics as communication**

The curriculum clearly states that one of the objectives in learning mathematics is to acquire the ability to communicate ideas through the use of mathematical symbols or ideas. An essential part of the curriculum is to help students attain the ability to comprehend mathematical statements encountered, for example, in the mass media. For example, students are expected to be able to interpret the statistics used in various reports they encounter in the mass media. In mathematics lessons, students are encouraged to work in groups on certain projects or problems.

### **Mathematics as reasoning**

The main goal statements clearly state the students need to develop the ability to think logically, systemically, creatively and critically. Although this is not clearly stated in the syllabus, teachers' guides and further elaboration of the syllabus specially encourage teachers to use approaches that can simulate mathematical thinking or reasoning. The use of statistics to critically examine information as part of the lesson, for example, can be said to be in correspondence with the aim of promoting the above thinking abilities.

### **Mathematical connections**

There is a strong emphasis in making connections within mathematics itself and across other subjects. In fact, the title of the curriculum suggests that making mathematical connections within itself or across other areas of study is strongly suggested. Making the connections between mathematics studied in class and material from everyday life or the environment are explicitly stated in the documents accompanying the syllabus. Through the introduction of certain facts concerning historical development in mathematics, the curriculum hopes that students will be able to see that mathematics has its origin and in many cultures and is developed as responses to human needs that are both utilitarian and aesthetic.

### **Concluding remarks**

The total framework of the intended curriculum places a heavy emphasis on problem solving, communications, reasoning and connections in mathematics. Other than these, another important feature that is being emphasized is to present mathematics as enjoyable, and yet challenging to their intellectual development. The relationships of mathematics to the real world is the basic theme used in all the topics of the syllabus. The curriculum is also responsive to the development of the information age. This is clearly seen in the "smart schools" program currently planned and implemented in students.

It is often argued that mathematics curriculum should not only provide students with the relevant knowledge to function well in society, but should also prepare them for further study at the higher education level. The present mathematics curriculum provides a broad-based mathematical knowledge, essential for students of higher learning in non-mathematically related areas of study mathematics curriculum. The secondary school curriculum provides the Additional Mathematics course for students who intend to embark on studies related to scientific and technological areas. The content of this curriculum is said to be sufficient for further studies in mathematics related areas. Studies that looked into the adequacy of this curriculum in providing students with the necessary mathematical skills and understanding for advanced scientific and technological studies is yet to be conducted.

## References

- Asiah Abu Samah (1984) **Perkembangan Kurikulum matematik sekolah di Malaysia sejak zaman penjajah**. Paper presented at the Seminar on mathematics education
- Bishop A.J. (1991) Mathematical values in the teaching process in A.J. Bishop and S. Mellin-Olsen & J.V. Dormolen (eds.) **Mathematical knowledge : Its growth through teaching**. Kluwer Academic Press.
- Christainsen, Howson and Otte (1986) **Perspectives on mathematics education**. D. Reidel Company
- Havelock, P.G. (1970) **A guide to innovation. Center for research on utilization of scientific knowledge**. D. Reidel Company.
- Kementerian Pendidikan Malaysia (1987) **Buku panduan khas matematik Tingkatan 2**, Dewan Bahasa dan Pustaka.
- Kementerian Pendidikan Malaysia (1988) **Buku panduan khas matematik Tingkatan 1**, Dewan Bahasa dan Pustaka.
- Kementerian Pendidikan Malaysia (1988) **Buku panduan khas matematik Tingkatan 3**, Dewan Bahasa dan Pustaka.
- Kementerian Pendidikan Malaysia (1989) **Kurikulum bersepadu sekolah menengah: Huraian sukatan pelajaran matematik Tingkatan 1**. Dewan Bahasa dan Pustaka. Kuala Lumpur
- Kementerian Pendidikan Malaysia (1989) **Kurikulum bersepadu sekolah menengah: Huraian sukatan pelajaran matematik Tingkatan 2**. Dewan Bahasa dan Pustaka. Kuala Lumpur
- Kementerian Pendidikan Malaysia (1989) **Kurikulum bersepadu sekolah menengah: Huraian sukatan pelajaran matematik Tingkatan 3** Dewan Bahasa dan Pustaka. Kuala Lumpur
- Kementerian Pendidikan Malaysia (1991) **Kurikulum bersepadu sekolah menengah: Huraian sukatan pelajaran matematik Tingkatan 4** Dewan Bahasa dan Pustaka. Kuala Lumpur
- Marsh, C. & Huberman, M. (1984) Disseminating curricula. A look from the top down. In **Journal of curriculum studies**, **16(1)** pp.53-66
- National Council for teachers of mathematics (1992) **Curriculum and evaluation standards for school mathematics**. National Council for the teachers of mathematics, Reston, Val.
- Liew, S.T. and Swetz, F. (1988) **Pengajaran matematik KBSR**. Fajar Bakti. Petaling Jaya.
- Mok Soon Sang and Lee Shok Mee (1986) Kurikulum baru sekolah rendah**. Longman, Kuala Lumpur.
- Polya G. (1974) **How to solve it. Third edition**. Double day.
- Yeoh O, Kanasabai S. & Hj. Ahmad (1977) **The curriculum development centre of Malaysia**. Collier-McMillan, London.