

An Evaluation of Senior Secondary Mathematics Curriculum System In Hong Kong

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Abstract: With the goal of “developing students’ mathematic capabilities, cultivating their generic skills, and improving their positive values and attitudes”, Hong Kong has designed a specific senior secondary mathematics curriculum system. It includes not only the explanation of curriculum concept and study purpose, but also the details of curriculum structure and teaching plan. The system is scientific, comprehensive, inter-connected and practical. Therefore, it has the important inspiration for mathematics curriculum reforms in other regions.
Key words: senior secondary mathematics curriculum in Hong Kong, reform, inspiration

I. INTRODUCTION

Since the school year of 2009-2010, Hong Kong has implemented a new educational system, which called “334”. It means 3 years for junior secondary, 3 years for senior secondary, and 4 years for college or university. Accordingly, Hong Kong re-designed the whole curriculum system for senior secondary.

Mathematics, as one of the four core subjects in Hong Kong senior secondary curriculum, has been paid great attention. The Curriculum Development Council and The Hong Kong Examinations and Assessment Authority jointly formulated the *Mathematics Curriculum and Assessment Guide (Secondary 4 - 6)* (hereinafter referred to as the *Guide*)([1]), which clarifies the rationale and aims of curriculum for new-designed mathematics curriculum. The *Guide* also describes the curriculum framework, curriculum planning, pedagogy, assessment and use of learning and teaching resources. It serves as a programmatic document for the Hong Kong senior secondary mathematic curriculum reform.

This paper introduces and analyzes the senior secondary mathematics curriculum in Hong Kong based on the *Guide*, so as to provide inspirations for mathematics curriculum reforms in other regions.

II. THE RATIONALE AND AIMS: HIGHLIGHT THE VALUE OF MATHEMATICS AND EMPHASIZE STUDENTS’ ABILITIES

2.1 The Rationale

The basic rationale of the senior secondary mathematics curriculum in Hong Kong includes: (1) In modern society, mathematics can effectively improve students’ abilities in solving problems by different ways – such as understanding, exploring, speculating and logical reasoning. (2) Mathematics provides approaches to obtain, organize and apply information, and plays an important role in expressing ideas through image, graph, symbol, description and analysis. Thus mathematics learning in senior secondary school lays a solid foundation for students’ life-long study. It also provides a platform helping students acquire new knowledge in a changing world. (3) Nowadays many plans and decision-makings depend on the application of measurement, structure, rules, graphics and quantitative data analysis. Therefore, the mathematic skills gained in senior secondary school help students to perform more easily to meet their work requirements. (4) Mathematics opens the door for students understanding the world better, and lays a foundation for other disciplines and advance education. (5) Mathematics enhances intelligence. By math study, students improve their imagination, enthusiasm, creativity and flexibility of thinking, and develop the abilities to appreciate the beauty of nature. Mathematics practice plays an important role in human culture development.

The presentation of the basic rationale has the following characteristics: (1) The function of mathematics is comprehensively described as a tool for understanding the planet, improving the thinking ability and strengthening the intelligence – additionally, a knowledge foundation for working and studying other subjects. (2) The specific description for mathematics, exemplified by specialized terms such as "image, graph, symbol, description and analysis", as well as "the application of measurement, structure, rules, graphics and quantitative

data analysis". (3) A distinctive feature of the times.

The presentation focuses mainly on the value of mathematics and how it affects students. For the curriculum construction, teaching and assessment, the *Guide* contains particular elaboration.

2.2 The Aim

The aim of the senior secondary mathematics curriculum in Hong Kong includes: (1) further improving students' mathematics knowledge, skills and concepts; (2) providing students with mathematical tool for personal development and prospective employment; (3) setting a foundation for those who will be majored in mathematics or mathematics-related subjects; (4) cultivating students' generic skills, especially the ability of using mathematics to reason, express and solve problems; (5) training students' enthusiasm and positive attitude; (6) enhancing students' confidence and ability of using mathematics into practice; (7) enabling students' mathematical genius.

The aim presented means the objectives. According to the above description, the objectives for the senior secondary mathematics curriculum in Hong Kong can be divided into three aspects: (1) further developing students' mathematical knowledge and skills; (2) cultivating students' generic skills (i.e. the nine abilities of collaboration, communication, innovation, critical thinking, IT utilization, operation, solution, self-management and research); (3) establishing students' positive values and attitude, which Hong Kong government regards as an important aspect of mathematics education. It enhances students' learning efficiency and helps to develop good character.

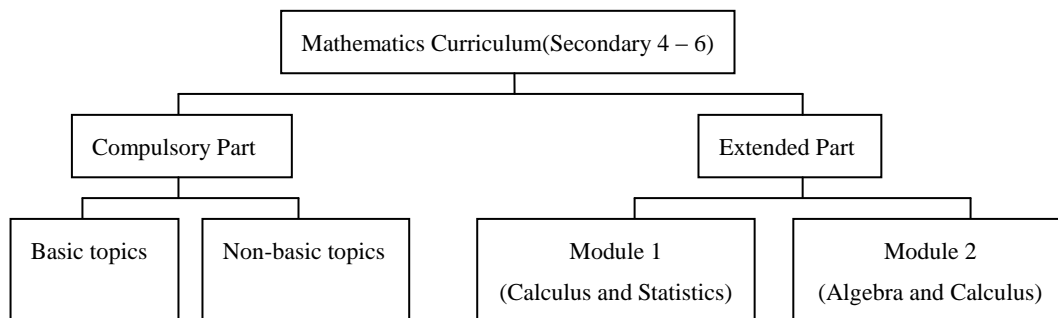
These objectives are consistent with the overall curriculum requirements in Hong Kong senior secondary school ([2][3]).

III. THE STRUCTURE: BALANCED, DIVERSE, AND FLEXIBLE; FOCUS ON LEARNING, PRACTICING AND INNOVATING

The *Guide* sets up the basic structure of the senior secondary mathematics curriculum in Hong Kong, requiring schools and teachers should regard the structure as the basis when engaged in teaching activities.

3.1 The Curriculum Structure

The basic structure of the senior secondary mathematics curriculum in Hong Kong is shown as follow:



The mathematics curriculum is divided into compulsory part and extended part. The compulsory part, as the basis of all students, contains the necessary mathematical knowledge and skills. Its content can further be classified into basic topics and non-basic topics. The former one requires all students master the knowledge which includes the necessary basic knowledge for the compulsory learning, and the consistent study plan which is composed of different chapters, allowing students to experience mathematics in various ways. Non-basic topics provide richer content for further education and prospective employment. Teachers can decide personally whether the content is worth teaching. The extended part consists of two different modules: Module 1 (calculus and statistics), for mathematical application, and Module 2 (algebra and calculus), for pure mathematical knowledge. Students who perform well and show interest in mathematics, or need more mathematical knowledge in the future, can study one module at most in the extended part, but the compulsory part is still necessary for them. In general, when learning mathematics in senior secondary school, students can have five plans: (1) the basic topics in the compulsory part only; (2) the basic topics in the compulsory part plus part of the non-basic topics therein; (3) the whole compulsory part; (4) the compulsory part plus Module 1; (5) the compulsory part plus Module 2.

As a core subject, mathematics curriculum accounts for 15% (about 405 hours) at most of the total class hours of the senior secondary school curriculum. The hour distribution for compulsory part and extended part is roughly listed below:

	Optimal hours (approx)
Compulsory part	270-338 hours
Compulsory part + One module	405 hours

3.2 The Compulsory Part

Compulsory part, as the most important, is divided into three strands – "Number and Algebra", "Measures, Shape and Space" and "Data Handling"; additionally plus the " Further Learning Unit " including "Further applications " and "Inquiry and investigation".

The design of compulsory part has the following characteristics:

(1) Detailed content, clear objectives, and highlighted knowledge points. The above three strands are actually a main line for mathematics curriculum through the primary, junior secondary and senior secondary school in Hong Kong. Each strand has clear objectives. For example, the objectives for "Data Handling" are "understanding the deviation measure; comparing data by selecting and using the central tendency and the deviation measure; studying and judging the credibility of inferences drawn by data; mastering basic counting skills; solving complicated probability problems by the simple formula; generalizing statistics and probability knowledge to solve practical problems." Each strand can be further divided into several units. For example, the strand "Measures, Shape and Space" is separated into four units: "Basic Properties of Circle ", "Locus", "Equations of Straight Line and Circle" and "More about trigonometry". For the focuses and hours of each unit, there are detailed descriptions.

(2) Emphasis on the close relationship between mathematics and human activities, as well as on cultivating students' abilities in solving practical problems. Take the " Further Learning Unit " as an example, the unit requires students to solve more complex problems in real life. It advocates finding related data during the solution, and exploring different strategies, or summarizing the ideas of different processes.

(3) Emphasis on students' innovative ability. The unit "Inquiry and investigation" requires students to discovery and construct knowledge by various learning activities, and further improve their abilities in exploring, exchanging, thinking and forming mathematical concepts, so as to obtain the ability of life-long learning.

The curriculum structure is based on the mathematics curriculum of primary school and junior secondary school, which embodies the curriculum idea and aim. The structure has the following characteristics: (1) The diversity. 5 different learning routes are set for students to choose according to their own situations. (2) The flexibility. Schools and teachers are free on content selection and hour arrangement, allowing them to teach based on specific conditions. (3) The balance. The balances between the breadth and depth, between the theory and the application are well achieved. (4) Emphasis on students' life-long learning ability. (5) Emphasis on enhancing students' positive values and attitude. In a word, the structure shows the student-oriented thought of serving for students.

IV. THE CURRICULUM PLANNING: COMPREHENSIVE, SPECIFIC AND EASY FOR IMPLEMENTATION

According to the guiding opinion of the *Guide* on how mathematics curriculum should be planned, and in order to develop a flexible balanced curriculum system in light of practical situations, these four steps should be followed:

4.1 The Guiding Principles

Schools in planning mathematics curriculum should adhere to the guiding principles. They are: students' cognitive development, students' prior knowledge, ability and aptitude, coherence of curriculum, teaching strategy, IT application, learning-promoting assessment and flexible schedule. Teachers are required to use specific examples during teaching activities to make the class more efficient; equal learning opportunities should be enjoyed by each student rather than by those who perform better or worse; the curriculum program should meet the needs for different students who choose other learning routes or will be engaged in math-related work; the

teaching should help students develop the ability of self-direction and life-long learning; Form for evaluation, beyond unit test, should be continuous assessment allowing students to understand and improve their prospective performance.

4.2 The Planning Strategies

The *Guide* requires schools lay down a clear and feasible objective for curriculum planning; flexible learning hours should be provided for students with different needs, abilities and interests; the depth of learning focus and the systematic arrangement of content should be properly adjusted; appropriate textbooks and other teaching resources are necessary; learning activities within one year need to be formulated; effective methods and models for assessment should be well designed.

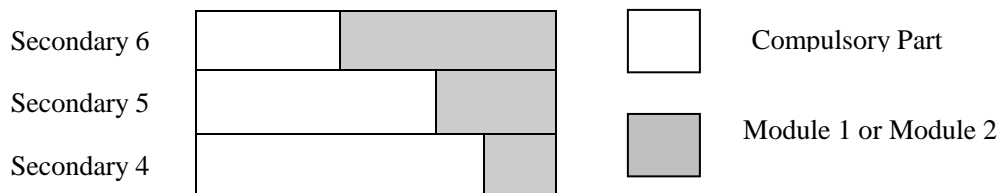
In addition, to strengthen the relationship between mathematics and other disciplines, teachers for different subjects should make joint efforts to formulate feasible teaching activities, so that students can use mathematical knowledge in different situations. For example, in terms of "Chinese language education", the content can involve the development of mathematics in the Chinese culture, the application of mathematics in ancient China, the contribution of the mathematics and mathematicians in China, and the history of π . When it is connected with the "Arts education", students can enjoy the visual arts from the geometry perspective, and appreciate the mathematics applications in music.

4.3 The Learning Progression

An average distribution of class hours is unnecessary; flexible arrangements are more reasonable. For students who study math-related subjects, more class hours in Secondary 4 is needed, and class hours in Secondary 5 and 6 could be reduced accordingly.

In Secondary 4, students can have an elementary contact with some content in optional Modules, and decide whether to study in Secondary 5.

The following table shows the proportions of compulsory part and extended part in each grade:



The order of units can be organized in different ways. Due to the links between knowledge points, teachers should pay attention to the prior knowledge for each topic. The *Guide* provides a flow chart showing the connections among topics, to facilitate teachers in course planning.

4.4 The Curriculum Management

With regard to the overall planning, the *Guide* requires curriculum leaders, principals, subject directors and teachers clarify their duties. For example, a subject director should assist, plan and supervise the curriculum implementation, determine clear objectives for teaching and assessment, and establish specific policies and effective implementing system. Also, a subject director should regularly organize a council to discuss connected issues, share experience, prepare lessons collectively, and collect evaluation feedbacks.

However, a curriculum framework doesn't mean everything. The effective implementation is more critical, which requires the teamwork among schools. Hong Kong has presented the detailed elaboration for curriculum planning, with strong operability, which determines duties for school and teachers. In this way, everyone should know how to ensure the teaching quality by conducting the mathematics class properly.

V. CONCLUSION

In addition to above contents, the *Guide* provides an elaboration on approaches, strategies, resources and evaluations of teaching and learning.

Current Hong Kong mathematics curriculum system establishment is based on extensive investigations and scientific theories. The innovative spirit, scientific attitude and work style of Hong Kong curriculum reform have set a great example for us. Regional sectors should take the reform as a reference to achieve continuous

improvement according to practical conditions, so that a better mathematics curriculum system for students' comprehensive development can be built.

REFERENCES

- [1]. Curriculum Development Council. Mathematics Curriculum and Assessment Guide (Secondary 4 - 6) [EB/OL].
- [2]. Curriculum Development Council. Basic Education Curriculum Guide (2002) [EB/OL].
- [3]. Curriculum Development Council . Senior Secondary Curriculum Guide (2007) [EB/OL].