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The Intended Curriculum and Cultural Traditions – A Comparative Case Study of Berlin and Hong Kong

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Many studies such as Pepin (1999a; 1999b), Kaiser (2002), and Park & Leung (2006) revealed that there is a strong dependence of mathematics teaching on cultural traditions in different countries. This study was set up as a detailed comparison between the intended curricula in Berlin and Hong Kong to explore how cultural tradition influenced the intended curriculum. In this study, the intended curriculum is what the (local, state or national) curriculum developers stipulate in the official documents. The German educational system is influenced by the curriculum tradition called Didaktik. Didaktik is a tradition about teaching and learning. Since 16th century, Didaktik has been the most important tool for planning, enacting, and thinking about teaching in most of northern and central Europe (Westbury, 1998). On the other hand, the education system in Hong Kong is influenced by both the Anglo-Saxon curriculum tradition and the Confucian heritage culture (CHC). It was found in this study that, although many studies revealed that there is a strong dependence on cultural traditions of mathematics teaching in different countries, other factors such as social factors or the education system also played an important part in shaping the intended mathematics curriculum. So a simplistic view of dependence of the curriculum on cultural traditions is not warranted. The formation of the curriculum is a much more complicated process encompassing various factors including needs of society, advancement of technology, and government policies at different levels.

Keywords: intended curriculum, Berlin, Hong Kong, Didaktik, Confucian heritage culture (CHC)
MESC Classification: A40, C60, D10
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0. INTRODUCTION

Many studies such as Pepin (1999a; 1999b), Kaiser (2002), and Park & Leung (2006) revealed that there is a strong dependence of mathematics teaching on cultural traditions in different countries. This study was set up as a detailed comparison between the intended curricula in Berlin and Hong Kong to explore how cultural tradition influenced the intended curriculum. In this study, the intended curriculum is what the (local, state or national) curriculum developers stipulate in the official documents. The German educational system is influenced by the curriculum tradition called *Didaktik*. Didaktik is a tradition about teaching and learning. Since 16th century, Didaktik has been the most important tool for planning, enacting, and thinking about teaching in most of northern and central Europe (Westbury, 1998). On the other hand, the education system in Hong Kong is influenced by both the Anglo-Saxon curriculum tradition and the Confucian heritage culture (CHC). Details of the curriculum traditions in the two cities will be discussed in Section 1. In Section 2, the methodology of this study will be depicted, and the results will be summarized in Section 3. There will be a discussion of the results in Section 4, and a conclusion in Section 5.

1. CULTURAL TRADITIONS IN GERMANY AND HONG KONG

Culture may refer to ideas, methods of thinking, values, belief, customs and traditions (Leung, Graf & Lopez-Real, 2006). Valsiner (1989, p. 503), for example, suggested that culture has been understood as "something that is, in its essence, shared in a qualitatively similar manner by all (or almost all) members of the given 'culture' (as a population, society, or an ethnic group)." Education in a particular social environment is influenced in many ways by the culture of such environment, and hence differs across countries or regions with different cultural background.

1.1. A brief summary of the mathematics education philosophy in Germany

Kaiser (1999, p. 149) suggested that the German educational philosophy is "characterized by the development of two approaches". They are the humanistic-oriented approach and the realistic-oriented approach for the masses.

1.1.1. The realistic-oriented approach

The German educational system is especially distinguished by a strong and early segregation of students by performance levels based on assessment results. After primary schooling, teachers and parents then decide where to place the students within the tripartite secondary school system, which are — *Hauptschule*, *Realschule* and Gymnasium. In general, students in Hauptschule focus mainly on vocational and technical training while in Gymnasium academics is much more important, and Realschule falls in-between. The concept of vocational schools was illuminated in the Age of Enlightenment. At that time, the curricula, as proposed by the mercantilists, were more oriented towards a special realistic-vocational conception of education for young people of the bourgeoisie. Content-based knowledge was more important (Kaiser, 2002), and the tripartite system is nowadays still in practice.

1.1.2. The humanistic-oriented approach

Didaktik is a tradition about teaching and learning in Germany. It is strongly related to the concept of *Bildung*. Gravemejer & Terwel (2000) suggested that Bildung refers to the ideal of personality formation, and does not only entail simply the transmission of knowledge. Bildung includes also the development of the knowledge, norms and values associated with 'good' citizenship and/or a membership of the cultural and intellectual élite. According to Howson, Keitel & Kilpatrick (1981), Bildung was to be interpreted in two ways: as the totality of knowledge and judgment, and as the process of education. It comprises learning as universal as ever possible with strong emphasize on humanities: philosophy, history, literature, art, music, but also with an emphasis on mathematics and sciences. The ideal was the completely cultivated, best educated human being, and "Bildung" was not a process ending at the end of one's studies, but just the base laid in the youth to be enlarged and enriched during the whole life. "Bildung" is an attitude and a path as much as an accomplishment (Keitel, 2006). Pepin (1999a, p.127) suggested that

> "Germany espouses mainly humanistic views, based on Humboldt's ideal of humanism, combined with naturalistic tendencies. Humboldt's concept of Bildung searches for 'rational understanding' of the order of the natural world. It incorporates encyclopedic rationalism as well as humanist moralism, and basically promotes the unity of academic knowledge and moral education. Therefore, teachers have traditionally held the two functions, that of academic specialist and, possibly to a lesser extent, that of moral educator. However, the humanist rationale was never allowed to avoid the importance of the study of mathematics and science subjects."

According to Hudson, Buchberger, Kansanen & Seel (1999, p. 1),

> "Didaktik itself can be seen as the science whose subject is the planned (institutionalized and organized) support for learning to acquire Bildung."

Since 16th century, Didaktik has been the most important tool for planning, enacting, and thinking about teaching in most of northern and central Europe (Westbury, 1998).

1.2. A brief summary of the mathematics education philosophy in Hong Kong

Hong Kong is a Special Administrative Region of the People's Republic of China and is also one of the places in East Asia rooted in the Confucian heritage culture (CHC). The Chinese are known to place a high emphasis on education, and this can be explained by the Confucian view of education. All Confucian-influenced places such as Japan, Korea, Singapore, Taiwan and Hong Kong share a similar view (Leung, 1999). Lee (1996, p. 28) pointed out that the Chinese emphasis on education "rests upon the Confucian presumption that everyone is educable." Confucius acknowledged that there are individual differences in intelligence, but he believed that "differences in intelligence ... do not inhibit one's educability". The aim of education is not the pursuit of knowledge for knowledge's sake, but the development of the character of the learner (Leung, 1999). However, in the traditional Chinese society, people did not pay much attention to mathematics. If people wanted to be a government official, they had to take examinations, and the examinations did not include mathematics. Mathematics in the former times was used in a pragmatic way. The aim of the Chinese mathematics classics *Jiuzhang suanshu* or *Nine Chapters on the Mathematical Art*, which contained 246 mathematical problems, is to find a general solution or a method to solve problems. This may be contrasted to the ancient Greek mathematicians, who tried to deduce propositions from axioms and postulates. Wang and Sun (1988) analyzed the development of mathematics in China from prehistoric times to the Yuan Dynasty. They concluded that there are five major characteristics of ancient Chinese mathematics. They are pragmatic, mystical, algorithmic, numerical and discrete, primitive dialectics, and conformity to orthodoxy. The traditional culture in China placed importance only on the applicability of mathematics. This may also be a contrast to the German education tradition, which was characterized by both humanistic- and realistic-oriented approaches.

Based on the above depiction of the Didaktik tradition and the CHC, this study explored the relationship between the intended curricula in mathematics and the curriculum traditions in the two cities. One contribution of this research is that it may be one of the most detailed studies on the comparison of mathematics curriculum in Berlin and Hong Kong. The key research problem of this study is: If mathematics education is culturally embedded, what are the cultural and intellectual underpinnings that influence the intended mathematics curricula in Berlin and Hong Kong at junior secondary level?

2. METHODOLOGY

It was suggested in one of the most influential studies, the Trends in International Mathematics and Science Study (TIMSS), that the intended curriculum represents the mathematics (and science) that the society intends for students to learn and how the education system should be organized to facilitate this learning (Valverde & Schmidt, 1997). Howson (1995) also stated that "nowadays curriculum guides are not, in general, simply lists of content. Aims and teaching methods should also be taken into account. The curriculum guides usually contain teaching guides and lists of processes through which it is hoped that students can acquire certain skills" (p. 55). The authors believed that there should be some factors contributed to the formulation of the curriculum and comparing the intended curricula in Berlin and Hong Kong can reflect these factors. In order to investigate these factors, we have to examine the intended curriculum in two dimensions: the intentions of the curriculum and the contexts of the curriculum. These two dimensions are coincident with the two components – the aims and the content as suggested by Howson (1995). The contents will be divided into three areas: Number and Algebra, Geometry, and Statistics and Probability. In the present study, the curriculum guides will be studied and interview will also be performed with the curriculum developers of the two cities.

In Berlin, the curriculum is developed and promulgated by the Department of Education, Youth and Sport of the Berlin Senate (Berlin Senatsverwaltung für Bildung, Jugend und Sport (BSBJS), 2006), and is described in "The Curriculum for the Secondary Level I (Grade 7–10)" (Rahmenlehrplan für die Sekundarstufe I (Jahrgangsstufe 7–10)). The contents are divided into three "keys", which means three levels. Students in the Hauptschule will study the contents with one key. Students in the Realschule will study the contents with two keys, which also cover the contents with one key. Students in the Gymnasium will study the contents with three keys, which cover all the contents. The contents in these 4 years are divided into two double-grades (Doppeljahrgangsstufe). In this study, only the first double-grades, *i. e.* Grades 7 and 8 in Gymnasium, would be considered.

Schools in Hong Kong have to follow the curriculum developed and promulgated by the Curriculum Development Council (CDC) of the Education Bureau (EDB). The source of the intended curriculum in Hong Kong is documented in "Syllabuses for Secondary Schools -- Mathematics" (Curriculum Development Council, 1999). The learning targets and objectives in Hong Kong are organized progressively across two Key Stages in the secondary schooling: Key Stage 3 (Secondary 1 to 3, corresponding to Grade 7 to 9 in Berlin) and Key Stage 4 (Secondary 4 to 5, corresponding to Grade 10 to 11). In this study, the intended curriculum in Key Stage 3 is compared with that in the first double grades (Grades 7 and 8) in Berlin. It is noted that there is one more year in the Hong Kong junior secondary school than the first double-grades in Berlin. In order to cater for the extra one year in the Hong Kong curriculum so as to have a fair comparison, this study also examines the part of the intended curriculum of the second double-grades

(Grades 9 and 10) in Berlin. Nonetheless, there is no clear delineation of the content in each year specified in the curriculum document. The unfairness of the comparison has to be taken into account.

Analysis of the documents is supplemented by interviews of the curricula developers. The interviews are analyzed qualitatively and are used to check the consistency against the curriculum documents and to see whether relevant support is given to teachers. For example, the documents suggested students to learn mathematics using information technology, but the way that this can be realized is not clearly written in the documents. Then relevant questions will be asked to clarify the intention of the curriculum. The interview questions are set with reference to a comparative study in Beijing, Hong Kong, and London by Leung (1992). Leung compared the influence of culture on mathematics education in the East and the West, and hence it would be suitable to set the questions with reference to his study. The interview in Berlin was conducted in June 2009, and two curriculum developers who were working in a secondary school were interviewed. The interview was conducted in both German and English and it lasted for one and a half hours. The interview in Hong Kong was conducted in September 2009, and the curriculum developer who was working for the Curriculum Developing Institute was interviewed. The interview was conducted in Cantonese and it lasted for 40 minutes. The translation in this study was done by the first author. The questions were related to the formation and the choice of contents of the curriculum. The curriculum developer interview question list can be found in Appendix B.

3. RESULTS

3.1. Aims

In the intended curriculum in Berlin, it is suggested that "education forms the prerequisite for continuous learning in students' later career and private life, enabling critical discussion between the development in the society and the social responsibility" (BSBJS, 2006, p. 9). Students in Berlin should:

interpret forms of society, nature and culture with the help of mathematics, understand phenomena and evaluate them (mathematics as an application),

recognize mathematical facts in the form of language, symbols, formulae and

illustrations as intellectual creations and develop them further (mathematics as a structure),

deal with creative and self-determined situations in which they solve problems with mathematical means (creativity in association with mathematics).

In Hong Kong, the secondary school mathematics curriculum continues the development of the learning of mathematics in the primary school. To enable students to cope confidently with the mathematics needed in their future studies, workplaces or daily life in a technological and information-rich society (BSBJS, p. 4: Chapter 2 Syllabuses for Secondary Schools – Mathematics), the curriculum aims at developing students:

the ability to conceptualize, inquire, reason and communicate mathematically, and to use mathematics to formulate and solve problems in daily life as well as in mathematical contexts;
the ability to manipulate numbers, symbols and other mathematical objects;
the number sense, symbol sense, spatial sense and a sense of measurement as well as the capability in appreciating structures and patterns;
a positive attitude towards mathematics and the capability in appreciating the aesthetic nature and cultural aspect of mathematics.

Mathematics education in both cities generally aims at forming the prerequisite for pupil's future, including further studies, career and daily private life. They also aim to develop students' problem solving skills for their everyday lives, in mathematical contexts or in science, and their abilities to manipulate numbers, symbols and other mathematical objects.

According to the curriculum developers in Berlin, the criterion in deciding the kinds of mathematics to be covered in the intended curriculum was directly related to what students need in their future lives. Students in Berlin were required to be equipped with mathematical knowledge or skills, and the choice of content was based on the applicability or the usefulness in everyday life. This is also the case in Hong Kong. On one hand, students in Hong Kong have to learn the concepts, methods, skills or theorems - the internal or core of mathematics. On the other hand, they have to use mathematics to interpret their society and to apply their knowledge to other disciplines or areas of practice. But there was one main difference between the curricula in Hong Kong and Berlin. The intended curriculum in Hong Kong expected students to conceive mathematics not only as a subject but as a culture. It is suggested that a holistic way in teaching and learning mathematics in Hong Kong is the ability to appreciate the aesthetic nature and cultural aspect of mathematics, the ability to manipulate mathematical objects, and the application of mathematics. Students not only had to learn those elements which were useful to their future live, but also learned how to appreciate the multi-cultural nature of mathematics.

3.2. Contents

There are five content areas in the policy documents in Berlin, namely: Number and

Algebra, Measures, Shape and Space, Functions, Statistics and Probability (BSBJS, p. 12: Chapter 2 Rahmenlehrplan für die Sekundarstufe I (Jahrgangsstufe 7–10)). On the other hand, the contents of the mathematics curriculum in Hong Kong are divided into three dimensions: Number and Algebra Dimension, Measures, Shape and Space Dimension and Data Handling Dimension (CDC, p. 4: Chapter 2 Syllabuses for Secondary Schools – Mathematics). The different content areas are discussed below.

3.2.1. Number and Algebra

According to the curriculum documents in the two places, 17 topics in Algebra are found, and sixteen of the topics are in common. That means the contents in Algebra that students in Berlin and Hong Kong have to learn are similar. Table 1 in the Appendix A illustrates the contents in Number and Algebra that students in Berlin and Hong Kong are required to learn.

3.2.2. Geometry

Basically, Geometry is divided into two main areas: 'Measures' and 'Shape and Space'. According to the curriculum documents in the two cities, 9 topics in Measures are found, and seven of them are in common. That means the contents in Measures that students in Berlin and Hong Kong have to learn are also similar. Table 2 in the Appendix A illustrates the contents in Measures that students in Berlin and Hong Kong are required to learn.

However, the contents in the Shape and Space are of Geometry (through an intuitive, a deductive, and an analytic approach) that students in Berlin and Hong Kong have to learn differ a lot. According to the curriculum documents in the two cities, 24 topics in the contents in learning geometry through an intuitive approach are found, and only 11 of the topics are in common to both the curriculum documents. Similarly four out of nine topics in learning geometry through a deductive approach are in common, and three out of eight topics in learning geometry through an analytic are in common.

It was also found that the intended curriculum in Berlin did not put much emphasis on learning geometry through a deductive approach, while the students in Hong Kong had to perform simple proofs related to different geometric figures. The intended curriculum in Berlin also did not put much emphasis on the coordinate geometry of straight lines as the Hong Kong one did. Three tables in the Appendix A illustrate the contents in Shape and Space that students in Berlin and Hong Kong are required to learn.

3.2.3. Statistics and Probability

Three topics in Statistics and five topics in Probability were found from the curriculum documents in the two places. All the topics are found in both curricula except one topic in Probability. So the contents in Statistics and Probability that students in Berlin and Hong Kong have to learn are similar. Table 6 in the Appendix A illustrates the relevant contents in the curricula in Berlin and Hong Kong respectively.

3.3. Discussion

The intended curricula in Berlin and Hong Kong share a number of similar topics in *Number and Algebra*, *Measures*, and *Statistics and Probability*, and the differences in the contents lie mainly in Geometry. The reason for the coverage of deductive and analytic geometry in the intended curriculum in Hong Kong may be that it puts more emphasis on the cultural aspect and the training of the mind. Studying geometry in this way makes students recognize and appreciate the deductive approach in mathematics. Students can learn how to verify, explain, and systematize a mathematical result through studying the deductive approach in geometry. For example, studying Pythagoras' theorem with proofs from different cultures makes students aware that mathematics is a dynamic field rooted in many different cultures. Recognizing Platonic solids makes them appreciate the precise and aesthetic aspects of mathematics. Students also have to learn formal proof as a way to train their minds.

In Berlin, as part of the curriculum was designed for the Realschule and the Hauptschule, the application of mathematics was emphasized. The curriculum developers suggested that the choice of the contents was based on the applicability or the usefulness in everyday life. This may be why there is no deductive geometry in the curriculum. Of course learning deductive geometry provides a good means to learn argumentations and the meaning of mathematical ideas or proof, but it does not provide a real-life motivation for learning mathematics. Even in higher grades, Grade 9 or Grade 10, the intended curriculum does not cover learning geometry from a deductive approach or analytic approach.

4. FURTHER DISCUSSION

It was suggested in the beginning of this paper that many studies revealed a strong dependence on cultural traditions of mathematics teaching in different countries. However in this study, we found that, contrary to the humanistic education philosophy in Germany, the intended curriculum in mathematics in Berlin stressed more on the application of mathematics. Surprisingly, in contrast to the traditional Chinese view on mathematics, the intended curriculum in Hong Kong tried to provide a balanced curriculum for the students, in terms of both the aims and contents. The understanding of the nature of mathematics, their structures and general principles was as important as the everyday usage of mathematics for the students in Hong Kong. The hidden notion may be that, other than cultural or traditional factors, there are some other factors which influenced the mathematics curriculum. These will be discussed below.

4.1. Berlin

4.1.1. School system

According to the curriculum developers in Berlin, there used to be 13 grades in the school system but it was recently changed to 12 grades. Therefore the high school syllabus has to cover the contents of 3 years in 2 years (the old one is from Grade 11 to Grade 13 and the new one is from Grade 11 to Grade 12). This has limited the developers in their design of the syllabus. For instance, the curriculum developers have to move some parts of the high school syllabus to the syllabus of junior secondary school, and thus the junior secondary school syllabus has to cover more content than before. On the other hand, primary school goes to the 6th grade, which is not normal in the rest of Germany (most of them go to the 4th grade). The primary school syllabus was written in 2004. The content in primary school also had to be taken into account. For example, students in the 6th grade started learning functions. The curriculum developers had to consider the knowledge of students when they prepared the curriculum documents.

4.1.2. Social factor

The use of mathematics in everyday life also influenced the syllabus. For example, in Berlin, there was a topic on Statistics which includes interpretation of data. This used to be taught in Grade 8 and Grade 11, but the topic was then changed to be taught in the junior secondary school. This was because even if some students did not go to high school, they still had to read newspapers and interpret data in everyday life. As one of the curriculum developers pointed out,

> "Statistics has become a topic more important in the syllabus. Some people said that it was too difficult for students but I think using easy or small numbers the topic could also be the one that students are interested in. Nowadays, it is so important for students to know statistics and handle data. This is because statistics plays an important role in the society and statistics can also be used to mislead people. No matter what school type a pupil is in, he or she has to learn statistics."

In short, the intended curriculum in Berlin places emphasis on what students need in their everyday lives. When the curriculum developers explained the criterion in deciding the nature and extent of mathematics to be covered, they stressed that the choice of content is directly related to what students might need in their future lives. For those who do not continue their studies after the 10th grade, they may still need the mathematics like geometry and percentages. One of the curriculum developers gave an example as follows: if a pupil becomes a painter, he or she needs to know geometry to calculate how many paints are needed for the wall. For those who want to go to high grades, they needed to learn about functions or exponentials graphs etc. So the basic consideration of the developers in designing the curriculum is always to prepare students for their future.

4.2 Hong Kong

In Hong Kong, the curriculum developer named three factors which are the consideration behind the drawing up of the mathematics curriculum. They are social factor, student factor and teacher factor. Similar to Berlin, social factor means the contents of the mathematics curriculum depend on what the students need for their future. Student factor includes how students learn, how they perceive mathematics, their computer knowledge and the knowledge of other electronic media, their metal calculating ability, the hobbies and their leisure time. As these are different from the past, the examples used in the same topic would also be different. Teacher factor includes teacher experience, the development of the teachers, how the teachers teach, the training of teachers and the mathematics background of the teachers. In addition to these, he also named three other factors which influenced the content of mathematics curriculum. He said:

> "The first one is the internal development of mathematics. This means if there are new kinds of mathematics developed. The second one is the external application of mathematics. The third one is the psychology in learning. How students learn one kind of mathematics may be different from the past. "

From the above, it can be deduced that, in addition to cultural factors, practical considerations such as the quality of teachers and school systems also had a great influence on the development of the intended curriculum.

4.3 Discussion

Germany has a rich culture in mathematics. Many mathematics theories were developed in Germany, and many great mathematicians in history such as Carl Friedrich Gauss, Bernhard Riemann and David Hilbert were German. Nonetheless, students in Berlin now do not necessarily learn or study the nature of mathematics as their ancestors did. As mentioned before, students were intended to learn mathematics for their future job or future study, and applications of mathematics were stressed. Using the terminology suggested by Kaiser (2002), the intended curriculum in Berlin was thus follows a realistic-oriented approach.

Hong Kong, on the other hand, is a special place because of its unique history. With a Confucian heritage culture, it adopted the Anglo-Saxon curriculum. The curriculum developer intended students to learn mathematics in a holistic way: the nature or origin of mathematics, mathematical theory and its applications. He hoped that the students would have more chances in presentation and would understand mathematics as a culture. This may be due to the westernization of mathematics education in Hong Kong (Siu, 2009). The mathematics in the former times was used in a pragmatic way, but now the curriculum developer wanted students to understand mathematics not just for its applications but also as a culture. This is not what a traditional Chinese would do. So probably the intended curriculum in Hong Kong has undergone some westernization and has included elements in traditional western mathematics such as deductive geometry. The pragmatics traditional Chinese approach to mathematics has been enriched by the Western humanistic-oriented approach in teaching mathematics.

5. CONCLUSION

Surprisingly, it is found in this study that there is a certain degree of "mismatch" in the intended curriculum in Berlin and Hong Kong. Traditionally, the mathematics culture in China was pragmatic while that in Germany was humanistic. Nonetheless, the intended curriculum in Berlin now stresses on the applications of mathematics while that in Hong Kong aims at educating students to conceive mathematics as a culture. Although many studies revealed that there is a strong dependence on cultural traditions of mathematics teaching in different countries, findings of this study suggest that other factors such as social factors or the education system also played an important part in shaping the intended mathematics curriculum. So a simplistic view of dependence of the curriculum on cultural traditions is not warranted. The formation of the curriculum is a much more complicated process encompassing various factors including needs of society, advancement of technology, and government policies at different levels.

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APPENDIX A

Table 1. The contents in Number and Algebra that students in Berlin and Hong Kong are required to learn

	Berlin	**Hong Kong**
Directed numbers and the number line	√	√
Numerical estimation	√	√
Approximation and errors	X	√
Rational	√	√
Irrational numbers	X (but in Grade 9 or Grade 10)	√
Using percentages	√	√
Rate and ratio	√	√
Proportions and inverse proportions	√	X (but in primary school)
Formulating problems with algebraic language	√	√
Manipulations of simple polynomials	√	√
Laws of integral indices	√	√
Laws of integral indices with negative exponents	X (but in Grade 9 or Grade 10)	√
Factorization of simple Polynomials	√	√
Linear equations in one or two unknown(s)	√	√
Identities and formulas	√	√
Linear inequalities in one unknown	√	√
Functions and their change	√	X (but in Grade 10 or Grade 11)

Table 2. The contents in Measures that students in Berlin and Hong Kong are required to learn

	Berlin	**Hong Kong**
Estimations in measurements	√	√
Area and circumference of circle	√	√
Areas of simple polygons	√	√
Surfaces areas and volumes of cubes, cuboids, prisms and cylinders	√	√
Arc lengths and areas of sectors	X (but in Grade 9 or Grade 10)	√
Volumes of pyramids, circular cones and spheres	X (but in Grade 9 or Grade 10)	√
Surface areas of pyramids, right circular cones and spheres	X (but in Grade 9 or Grade 10)	√
the relationships between sides, surface areas and volumes of similar figures	X	√
distinguish between formulas for length, area, volume by considering dimensions	X	√

Table 3. The contents in Geometry (through an intuitive approach) that students in Berlin and Hong Kong are required to learn

	Berlin	**Hong Kong**
Recognize the common terms and notations in geometry such as line segments and angles	√	√
Recognize the common terms and notations in geometry such as regular polygons, cubes and regular polyhedra (Platonic solids) etc	X	√
Identify and describe geometric objects	√	√
Construct geometric figures	√	√
Recognize different types of angles (acute, obtuse and right)	√	√
Construct polygons, circles, parallel, perpendicular lines and angle bisector by compass and ruler	√	√
Construct perpendicular bisectors, special angles and special polygons by compass and ruler	X	√
Construct special lines in triangle (height, median, angle bisector and bisector)	√	√
Sketch the cross-sections of solids	X (but in Grade 9 or Grade 10)	√

Table 3 (cont.)	Berlin	Hong Kong
Explore geometric relationships through the use of dynamic geometry software	√	X
Explore and identify the net of a given solid	√	√
Examine the solubility and the variety of solutions of different construct problems	√	X
Sketch figure for problem solving	√	X
Identify whether two triangles are congruent with simple reasons	√	√
Identify whether two triangles are similar with simple reasons	X	√
Transformation: recognize the effect on 2-D shapes after the transformation including reflection, rotation, translation, dilation/contraction, etc. Symmetry: recognize reflectional and rotational symmetries in 2-dimensional shapes	√ (in the elective topics)	√
Use the angle properties associated with intersecting lines and parallel lines	X	√
Use the properties of lines and angles of triangles	√	√
Use the formulas for the angle sum of the interior angles and exterior angles of polygons	√ (in the elective topics)	√
Explore regular polygons that tessellate	X	√
Extend the idea of symmetry in 2-D figures to recognize and appreciate the reflectional and rotational symmetries in cubes and tetrahedron	X	√
Imagine and sketch the 3-D objects from given 2-D representations from various views	X	√
Recognize the limitation of 2-D representations in identifying the solid	X	√
Explore and identify the properties of simple 3-D object such as the projection of an edge on one plane, the angle between a line and a plane and the angle between 2 planes	X	√

Table 4. The contents in Geometry (through a deductive approach) that students in Berlin and Hong Kong are required

	Berlin	**Hong Kong**
Develop an intuitive idea of deductive reasoning by presenting proofs of geometric problems relating with angles and lines	X	√
Explore and recognize the relations between the lines of triangles such as the triangle inequality, concurrence of intersecting points of medians etc	√ (in the elective topics)	√
Explore and justify the methods of constructing centres of a triangle such as in-centre, circumcentre, orthocentre, centroids etc.	X	√
Pythagoras' Theorem	X (but in Grade 9 or Grade 10)	√
Extend the idea of deductive reasoning in handling geometric problems involving quadrilaterals	X	√
Deduce the properties of various types of quadrilaterals but with focus on parallelograms and special quadrilaterals	√	√
Perform simple proofs related with parallelograms	X	√
Use the mid-point and intercept theorems to find unknowns	X	√
Proof of the theorem of Thales	√	X (but in Grade 10 or Grade 11)

Table 5. The contents in Geometry (through an analytic approach) that students in Berlin and Hong Kong are required to learn

	Berlin	**Hong Kong**
Use the rectangular and polar coordinate systems to describe positions of points in a plane	X	√
Locate a point in a plane by means of an ordered pair in the rectangular coordinate system	√	√
Describe intuitively the effects of transformation such as translation, reflection with respect to lines parallel to x-axis, y-axis and rotation about the origin through multiples of 90° on points in coordinate planes	√ (in the elective topics)	√
Calculate areas of figures that can be cut into or formed by common 2-D rectilinear figures	X	√
Use formula of distance	X	√
Use formula of slope	√	√
Use ratio to find the coordinates of the internal point of division and mid-point	X	√
Understand the conditions for parallel lines and perpendicular lines	X	√

Table 6. The contents in Statistics and Probability that students in Berlin and Hong Kong are required to learn

Statistics	**Berlin**	**Hong Kong**
Data collection	√	√
Organization and representation of data	√	√
Construction and interpretation of simple diagrams and graphs	√	√
Probability	**Berlin**	**Hong Kong**
Explore the meaning of probability through various activities	√	√
Investigate probability in real life activities	√	√
Calculate the theoretical probability by listing the sample space and counting	√	√
Have an intuitive idea about the relation between probability and the relative frequency as found in statistics or simulation activities	√	√
Recognize the meaning of expectation	X	√

APPENDIX B

Curriculum developer interview question list

Background

1. What is the background/consideration behind the drawing up of the mathematics syllabus?
2. What factors influenced the content of mathematics in the syllabus? Is there any factor other than education factors? How? Why?

Content

3. What is the criterion in deciding what kinds of nature and extent of mathematics are to be covered?
4. On what basis are the contents of algebra selected for the syllabus? Why?
5. Is there any proportion of Algebra, Geometry and Statistics suggested in the syllabus? If so, what is it?
6. Do you think that the content of syllabus is the same as your ideal/proposed one?

Attitudes

7. Is there any assistance to the teachers or students for using modern technology appropriately to teach or to learn mathematics?

Berlin

8. In the curriculum documents, it is stressed that students should attain "presentation and communication" skills. How do you expect teachers to encourage students to present mathematics in class? Also what kind of communication skills should students attain?
9. What does Modelling mean? What are the differences between Modelling and Application of Mathematics in daily life?

Hong Kong

10. How do you expect teacher to teach students to appreciate "mathematics is a dynamic field with its roots in many cultures", "the precise and aesthetic aspect of mathematics" and "the role of mathematics in human affairs"?

Evaluation

11. What is the limitation of the current mathematics syllabus?
12. What do you suggest to modify and improve the mathematics syllabus?
13. Please comment on or give suggestions to refine the mathematics syllabus.