

Upper secondary education in Hong Kong: a case study

Mary James

This report forms part of a collection of six case studies commissioned by the Royal Society in 2017 examining upper-secondary education reform in different jurisdictions. The case studies are designed to give the reader an understanding of the trends in upper secondary curriculum reform and, in particular, the recent moves that certain jurisdictions have made towards a broader and more balanced curriculum.

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About the author

Mary James, FAcSS, formally retired as professor and associate director of research from the University of Cambridge Faculty of Education in 2014. She previously held posts at the Institute of Education London, the Open University and in three secondary schools. She is a Past President of the British Educational Research Association (2011-13) and was Deputy Director of the ESRC's Teaching and Learning Research Programme (2002-08), within which she directed the 'Learning how to Learn' project (2001-05). In 2011 she was a member of the Expert Panel to the Coalition Government's National Curriculum Review in England. She has been an occasional adviser to the Hong Kong Education Bureau on its educational reforms since 2000, and was the overseas member of the Hong Kong Curriculum Development Council from 2007 to 2009 when it was developing the new senior secondary curriculum and examinations. Email: mej1002@cam.ac.uk

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Glossary of terms

ApL	Applied Learning
AS	Advanced Subsidiary (examination)
CDC	Curriculum Development Council
CIE	Cambridge International Examinations
CPSS	Committee on the Prevention of Student Suicides
EC	Education Commission
EDB	Education Bureau
ESRC	Economic and Social Research Council (UK)
GCE	General Certificate of Education (UK)
HKALE	Hong Kong Advanced Level Examination
HKCEE	Hong Kong Certificate of Education Examination
HKDSE	Hong Kong Diploma of Secondary Education
HKEAA	Hong Kong Examinations and Assessment Authority
HKIEd	Hong Kong Institute of Education
IES	Independent Enquiry Study
IT	Information Technology
LS	Liberal Studies
MTR	Mid-Term Review
NARIC	National Recognition Information Centre (UK)
NAS	New Academic Structure
NRA	National Record of Achievement (UK)
NSS	New Senior Secondary curriculum
Ofsted	Office for Standards in Education (UK)
OLE	Other Learning Experiences
PD	Professional Development
PRC	People's Republic of China
SAR	Special Administrative Region
SBA	School-based assessment
SLP	Student Learning Profile
SRR	Standards-referenced reporting
SS	Senior secondary
STEM	Science, Technology, Engineering and Mathematics
UCAS	University and Colleges Admission Service (UK)
UGC	University Grants Committee

Summary

In 2002 Hong Kong embarked on a carefully planned and enormously ambitious 10-year reform of its education system. Central to this was a decision to replace the old British system of 16+ and 18+ examinations, for a selected few, with a unified system of senior secondary education for all 15 to 17 year olds, followed by the introduction of four-year degree courses for those achieving the required profile in the new Hong Kong Diploma of Secondary Education (HKDSE).

The central aim of the reform was to promote all-round (whole person) development of students and a disposition towards lifelong learning in order to meet the needs of life and work in the 21st century. A new curriculum was designed comprising core subjects, elective subjects, applied learning subjects, other languages, and other learning experiences related to moral, civic, career, aesthetic and physical development. Achievement in all of these areas is captured in the HKDSE, which draws on formal examination, school-based assessment and a student's own learning profile. The reforms have been particularly successful in increasing access of students to senior secondary studies – double the number now leave with the HKDSE compared with the numbers attaining certificates under the old system.

Science subjects are not part of the core but are popular as elective subjects, especially single sciences, which have always had a high status in Hong Kong. Numbers of entries to these subject examinations have increased somewhat. An extensive international benchmarking exercise indicates that the standard of attainment has been maintained. A much larger proportion of candidates now attain the very highest grades (equivalent to Grade A at A Level). More worrying has been the drop in 2015 PISA ranking for 15 year olds in science literacy. There are also concerns about gender differences in science subject choice and performance. Hong Kong has responded by offering extra resources to schools for STEM subjects.

The broadly based Diploma facilitates multiple and flexible pathways through tertiary education and into employment. More than 85% of the first cohorts of school leavers progressed to further study, with about 40% enrolled on undergraduate programmes.

These reforms entailed change in every part of the education system and required thorough, on-going coordination, evaluation and renewal. This was costly and government expenditure increased. Support for the recruitment and training of teachers and school leaders has been particularly important. There have been worries, particularly about workload for students and teachers, but much has been gained in terms of students' broader knowledge and skills, and enhanced self-confidence.

Other countries can learn that it is possible to establish a broad and balanced senior secondary curriculum without sacrificing excellence. The crucial condition has been the opportunity to plan and implement a long-term, publicly agreed, reform programme protected, thus far, from too much political interference.

1. Introduction

In 2002, Hong Kong embarked on a bold and radical ten-year programme of educational reform, focusing on curriculum and assessment but with profound implications for all aspects of the educational system. By 2009, these reforms had worked through to senior secondary education. In 2012, the first students qualified with the new Hong Kong Diploma of Secondary Education (HKDSE). The aim of the reforms was to broaden and deepen students' educational experiences in order to develop their all-round capabilities and dispositions towards lifelong learning in a rapidly changing globalised world. At the same time its purpose was to strengthen their ability to contribute to the continued growth of Hong Kong as a vibrant economy at the interface between East and West. For these reasons, recent attempts to broaden the post-16 curriculum in Hong Kong are worthy of attention by policy makers in other countries, especially in the United Kingdom.

2. The political and policy context behind reform of the curriculum

Hong Kong is a Special Administrative Region (SAR) of the People's Republic of China (PRC). It has a population of approximately 7.4 million concentrated in 1,105.7 square kilometres of territory (c.f. London's population of about 8.6 million in 1,572 square kilometres). The fertility rate is low and declining (1.23, compared to UK's 1.83) but the population is rising because of increasing inflow of one-way permit holders (51,300 in 2016), mainly from Mainland China.

The SAR was established on 1 July 1997 when Hong Kong ceased to be a British colony and was returned to Chinese sovereignty. This was a hugely significant event in the history of Hong Kong's education system which had been modelled on the British one. The Sino-British Joint Declaration acknowledged that the existing education system would remain essentially unchanged after handover. However, the constitutional document for the HKSAR (the Basic Law), which stipulates a policy of 'One Country, Two Systems,' promised a high degree of autonomy in the way Hong Kong would be ruled. Thus, the HKSAR Government sought to improve education in response to wider social change. Hong Kong sees itself as a 'Regional Education Hub' where East meets West and where students are prepared to meet the challenges of a globalised world. A specific driver is the perceived need to manage the transition from manufacturing to a knowledge-based service economy; financial and trading services are particularly important in Hong Kong.

Both before and after handover, the provision of schooling has been diverse. There are three main types of local schools: government schools; aided schools (where students do not have to pay) run by voluntary bodies often with Christian, Buddhist or charitable foundations¹; direct subsidised schools (funded by government but where students have to pay)²; and private schools, some with government assistance. There are also 51 international schools offering non-local curricula, mainly to children of overseas families. The first two categories offer free education and deliver the Government's recommended curriculum. However, the steadfast policy has been to allow some flexibility of choice in schooling, hence the diversity in types of schools and curricula under the new senior secondary (NSS) arrangements.

¹ The Hong Kong Jockey Club supports a number of educational institutions.

² Direct subsidised schools can offer non-local curricula, such as iGCSE or the International Baccalaureate, for not more than 50% of their students.

Under the old British system, education was highly selective and elitist. Children were only entitled to nine years of education (to age 14) and access to senior secondary education was limited to one third of the cohort, regardless of their potential to succeed in Hong Kong's school examination system. Access to the highest of five bands of secondary schools, which allowed progression to senior secondary schooling, was determined by tests at the end of primary schooling. In 2001, these tests were judged to be gender-discriminatory because scaling of scores used separate gender curves, students were banded by gender, and gender quotas for co-educational secondary schools were imposed. All of these features had been adopted from the pre-1965 British 11+ system of selection for grammar schools. Something had to be done, not only to provide fairer access to senior secondary education but to broaden and deepen the educational experience and achievements of all students in order to meet the challenges of a complex 21st century social and economic environment, locally and globally, and to sustain the development of Hong Kong as an international region.

Before handover, the HK Government set up the Education Commission (EC), the most important education advisory body in Hong Kong. In 2000, after extensive consultation, the EC published a report, *Learning for Life, Learning through Life – Reform Proposals for the Education System in Hong Kong*. This was to set the future direction for radical, root-and-branch reform.³ For the first time in Hong Kong, it articulated the broader purpose of promoting the **all-round (whole person) development** of all students, according to their abilities, and to promote their **life-long learning**. In contrast with the old system, this was premised on the belief that all students can learn and succeed if given appropriate opportunities and that they should be prepared for learning throughout their life as circumstances change. There was also a desire to encourage students to develop a heightened sense of agency and greater independence in their learning through changes in teaching. Pedagogy had previously placed great reliance on rote learning of the content of textbooks and drilling for tests and examinations. In sum, the old system was considered no longer suitable for the 21st century.

The first changes included entitlement to 12 years of free education for all students, i.e. to the end of Secondary 6 (S6) at age 17 (equivalent to Year 12 in England). Alongside this was the creation of a new **3-3-4** academic structure (NAS) for post-primary education. This represents **3** years of junior secondary education, building on the basic education of six years of primary education. The next **3** years of senior secondary education was introduced as an entitlement for all students, beginning at age 14 (equivalent to Year 10 in England) and including those with 'intellectual disabilities'. Previously there had been no senior secondary curriculum provision for students with special educational needs so their inclusion in the new senior secondary (NSS) reform programme generated a great deal of debate and successive changes in language and provision. As with all mainstream students, they too would be encouraged to work towards a HKDSE, to be completed at age 17. **4** years of higher education would then follow for those accepted for local universities and many universities in other countries, including Mainland China. This was a radical departure from the old 5-2-3 structure which replicated the English model, i.e. five years of secondary education concluding with the Hong Kong Certificate of Education Examination (HKCEE, equivalent to the old GCE O Level in England), followed by two years of education, to 18 or 19 years of age, preparing for the HKALE (Hong Kong Advanced Level Examination, equivalent to the GCE A Level in England), followed by a three year degree course which was then the standard in Hong Kong and English universities.

³ An English Language version can be found at: <http://www.info.gov.hk/archive/consult/2000/Full-Eng.pdf>

Although part of the motivation for the NAS in Hong Kong was a perceived need to bring the HKSAR into line with academic structures elsewhere, there were strong educational reasons as well. The professional executive branch, the Education Bureau (EDB), tasked with implementing these changes, was well aware of educational debate, proposals and developments elsewhere in the world, including Mike Tomlinson's 2004 proposals for a unified framework for 14-19 learning in England.⁴ Of special concern was the need to create multiple pathways for secondary school graduates because drop-out rates were considered too high under the old HKCEE/HKALE system. Not only was there an expectation of better access to higher education (bachelor's degrees, sub-degrees, distance learning) but also access to vocational programmes and the workplace, at home and abroad. A range of one-year diplomas, acting like a foundation year, was introduced to enable students to come back into the university system in the second year of the new 4-year courses. One of the greatest successes of the 3-3-4 NAS has been increases in staying on rates. A survey of students who left secondary education in 2012, the first year of the HKDSE, indicates that around 88% of 59,871 respondents from 432 schools (90.8% of all schools) continued to further studies locally or outside of Hong Kong.⁵

3. The main features of the upper secondary curriculum in Hong Kong

The New Senior Secondary (NSS) curriculum was part of the coordinated, ten-year programme of all-through educational reform, designed to rethink the role of education in the post-colonial phase (see above). This began formally in 2001 when the Curriculum Development Council (CDC), the freestanding advisory body to Government on curriculum matters, published a blueprint taking forward the recommendations of the Education Commission in 2000. The CDC document was entitled *Learning to Learn – The Way Forward in Curriculum Development*.⁶ 'Learning to Learn' subsequently became the label by which the reforms are known. The current iteration is referred to as *Learning to Learn 2.0*.

In terms of implementation, reforms were introduced progressively, starting in 2002 with changes to basic education in primary and junior secondary. Then, in 2009, the NSS was introduced, with the first 'graduates' of the HKDSE emerging in 2012. Those who then went on to four-year university degree programmes graduated, for the first time, in 2016.

3.1 Aims and learning goals

The coordinated approach to reform made coherence a key objective: coherence across curriculum, pedagogy and assessment, and coherence across the phases of education. To this end, agreement to a set of common principles and learning goals was deemed essential. In a joint report on its Medium-term Review (MTR) in 2015⁷, the Curriculum Development Council (CDC), the Hong Kong Examinations and Assessment Authority (HKEAA) and the Education Bureau (EDB) reiterated the overarching aim that the reforms should "provide all students with essential lifelong learning experiences for whole-person development in the domains of ethics, intellect, physical development, social skills and aesthetics, according to individual

⁴ This can be downloaded from: <http://www.educationengland.org.uk/documents/pdfs/2004-tomlinson-report.pdf>

⁵ <http://334.edb.hkedcity.net/doc/eng/FullReport.pdf>

⁶ A Web edition can be found at: <http://www.edb.gov.hk/en/curriculum-development/cs-curriculum-doc-report/wf-in-cur/>

⁷ http://334.edb.hkedcity.net/doc/eng/MTR_Report_e.pdf

potential, so that all students can become active, responsible and contributing members of society, the nation and the world.” (p.3)

In line with this general aim, the MTR report (p.4) also re-confirmed seven learning goals. Students should:

- be biliterate (Chinese and English) and trilingual (Cantonese, Putonghua/Mandarin, English) with adequate proficiency;
- acquire a broad knowledge base, and be able to understand contemporary issues that may impact on daily life at personal, community, national and global levels;
- be informed and responsible citizens with a sense of global and national identity;
- respect pluralism of cultures and views, and be critical, reflective and independent thinkers;
- acquire information technology (IT) and other generic skills as necessary for being lifelong learners;
- understand their own career/academic aspirations and develop positive attitudes towards work and learning; and
- lead a healthy lifestyle with active participation in aesthetic and physical activities.

To these ends, a NSS was constructed comprising core subjects, elective subjects, applied learning, other languages, and other learning experiences (OLE).

3.2 Core subjects

There are four subjects in the core: Chinese language, English language, mathematics, and liberal studies. Mathematics has two parts: a Compulsory Part and an Extended Part. The Extended Part has two options: Module 1 (calculus and statistics) and Module 2 (algebra and calculus). As the labels imply, only the Compulsory Part is considered an essential part of the core and included in outcome measures for this element of the curriculum. The Medium-term Review recommended that, for those students taking the Extended Part, given the level of additional demand, the results should be considered as a separate elective subject. In some respects it is comparable to Further Mathematics in the UK A Level.

It is significant that science is not part of the core. This is not unusual in countries where there is an expectation that a second language, often English, should be learned alongside the first language and mathematics. One could also argue that in Hong Kong there is no need to make sciences compulsory because they have always been both high status and popular. For the past three years – 2015, 2016 and 2017 – the elective subjects of biology, chemistry, physics and economics have had the highest number of candidates for examination (see Section 4 below).⁸

It is worth mentioning the reasons for including Liberal Studies (LS) in the core. In line with the overall aims and goals of the educational reforms, the explicit aim of LS has been to broaden the knowledge base of all students and enhance their social, national and global awareness as well as developing their ability to examine a wide

⁸ In 2014, 'Business, Accounting and Financial Studies' also had a high number of candidates but from 2015 this subject was reclassified as two – 'Accounts' and 'Business Management' – and, recorded separately. So they fell out of the top group. As an historic trading economy, these subjects also remain very popular in Hong Kong.

range of issues from multiple perspectives. Special attention has been paid to developing creative and critical thinking skills, demonstrated primarily through an independent enquiry study (IES).

3.3 Elective subjects

Elective subjects include 20 more established academic senior secondary (SS) subjects. Science, technology, engineering and mathematics (STEM) subjects feature prominently in the list of 20 SS electives. These include biology, chemistry, design and applied technology, economics, information and communications technology, physics, science, technology and living.⁹ The subject labelled 'science' takes two forms: 'combined science' and 'integrated science'. 'Combined science' has three variants: biology + chemistry; biology + physics; chemistry + physics. As mentioned earlier, the Extended Part of mathematics is being considered as an elective, i.e. as additional to the Compulsory Part, which is in the core.¹⁰ (See Table 1 for the numbers of day school 'first attempters' who sat these subjects in the 2017 HKDSE.)

The knowledge content of established academic subjects does not differ radically from similar courses elsewhere. What is more radical is the structure of, and access to, the HKDSE as a whole, its overall aims and approach, and the attention given to skills, processes, values and attitudes in the curriculum guides for each subject.¹¹

⁹ 'Technology and Living' is focused mainly on food, textiles and family relationships.

¹⁰ At the time of writing, the whole of the mathematics curriculum is undergoing revision and is subject to consultation, see: <http://www.edb.gov.hk/en/curriculum-development/kla/ma/consultation.html>

¹¹ Subject details can be found at <http://334.edb.hkedcity.net/EN/curriculum.php>

Table 1: NSS and HKDSE Core and Elective subjects, and numbers of day school students (first attempters) who sat these in 2017

4 Core and 20 Elective Subjects			No. sat in 2017
Biology			13 249
Business, Accounting and Financial Studies	Accounting		7 548
	Business Management		2 797
Chemistry			12 500
Chinese History			5 640
Chinese Language (core)			49 384
Chinese Literature			1 582
Design and Applied Technology			703
Economics			13 082
English Language (core)			49 913
Ethics and Religious Studies			700
Geography			9 295
Health Management and Social Care			817
History			5 154
Information and Communication Technology			5 435
Liberal Studies (core)			50 188
Literature in English			298
Mathematics	Compulsory Part (core)		49 761
	Extended Part (Calculus and statistics)		2 584
	Extended Part (Algebra and Calculus)		4 140
Music			163
Physical Education			931
Physics			10 293
Science	Combined Science	Biology + Chemistry	441
		Biology + Physics	46
		Chemistry + Physics	359
	Integrated Science		128
Technology and Living	Food, Science and Technology		156
	Fashion, Clothing and Textiles		51
Tourism and Hospitality Studies			3 680
Visual Arts			3 563

Source of data: HKEAA Press Release for 2017: Hong Kong Diploma of Secondary Education Examination Results Released. Downloadable from http://www.hkeaa.edu.hk/en/hkdse/admin/release_of_results/

3.4 Other Languages and Applied Learning

Students can also elect to study six other language subjects (French, German, Hindi, Japanese, Spanish and Urdu), and a wide range of Applied Learning (ApL) subjects. ApL subjects aim at enabling students to understand fundamental theories and concepts through application and practice as well as developing their generic skills in an authentic work situation. They have a more vocational orientation.

ApL subjects are grouped under six categories: applied science; business, management and law; creative studies; engineering and production; media and communication; services. Within the 'applied science category' there are seven subjects: applied psychology; exploring psychology; foundation of Chinese medicine; fundamental health care; health care practice; medical laboratory science; sports and fitness coaching. Within 'engineering and production' there are five subjects: automotive technology; aviation studies; building technology; environmental engineering; mobile and online apps development. Aviation studies and health care practice were the most popular subjects in these categories in 2016 and 2017.

The wide range of SS subjects available is intended to provide for a broad and balanced curriculum allowing students to select academic subjects, more vocationally oriented subjects, or a combination of both. Thus, any number of combinations is possible, all leading to the common HKDSE. However, schools select from this range of subjects on offer according to their local context and their assessment of their students' needs.¹² Annual surveys by the EDB indicate that schools in general offer 10 to 12 electives each. Students are expected to choose 2 or 3 electives, in addition to the four core subjects. The Medium-term Review report in 2015 noted that students are now taking fewer electives (usually two) in order to better manage their workload across at least six (but no more than eight) formally assessed subjects.

3.5 Other Learning Experiences (OLE)

Building on the foundation of the learning experiences gained in basic education (Primary 1 to Secondary 3), OLE is considered to be an essential part of the senior secondary curriculum. It is particularly focused on the development of the whole person and provides activities in five areas: moral and civic education; career-related experiences; community service; aesthetic development; physical development. Achievements in these areas are not formally assessed, but students are encouraged to develop their own Student Learning Profile (SLP) as a record of, and reflection on, their own learning journey. Achievements in out-of-school competitions and activities may be included in this. The primary purpose is to broaden the scope of learning, personal development and self-evaluation. The SLP should also serve as a reference¹³ when applying for admission to post-secondary and university education and employment. However, the 2014 external evaluation by Cambridge University and the 2015 Medium-term Review concluded, on consistent evidence from students and principals, that greater recognition of OLE and the SLP was still needed.

¹² Hong Kong schools are not fully comprehensive. The five bands that existed before 2002 were reduced to three bands, and the allocation of school places is now determined far more by parental choice. However, schools in different bands and different contexts offer different subject choices and HKDSE entry levels.

¹³ Rather like the National Record of Achievement that was introduced in schools in England in 1991 but fell out of use as political priorities changed.

3.6 The Hong Kong Diploma of Secondary Education (HKDSE)

The HKDSE certificate is, in essence, a profile that records the range of experiences and achievements of students in their senior secondary schooling. The way in which the various subjects are assessed and reported differs according to the category in which they are placed. There are three such categories: A, B and C.

3.6.1. Category A (SS) Subjects, including the 4 core subjects and the 20 elective subjects.

The HKDSE examination in these subjects (see Table 1) adopts a standards-referenced reporting (SRR) system. Student performance is assessed according to a detailed set of prescribed descriptors that define the typical performance of students at each of five levels (Levels 1 to 5).¹⁴ Ungraded (U) can also be reported in national statistics although no result below Level 1 is reported in the HKDSE certificate for individual students. At the high end of the scale, Level 5 is subdivided into three (5, 5*, 5**).

The HKEAA undertook an extensive international benchmarking exercise in order to set the levels for Category A subjects. This provided evidence for its claim that Level 5 is equivalent to Grade A in UK Advanced Level examinations, and that Level 5* is equivalent to Grade A*. Level 5** exceeds Grade A* but was seen as necessary in order to meet the increasing demands of some elite universities for the highest quality graduates from the school system. 5** is awarded to only a very small proportion of candidates for examination (see, for example, Tables 2.1, 2.2 and 2.3 in Section 4). The 2015 Medium-term Review reported that the majority of schools were satisfied with the grading structure for HKDSE Category A subjects, although there were some suggestions that 5** should be abolished, arguing that this had aggravated the washback effect of the HKDSE Examination on student learning. In other words, it had accelerated competition for the highest grades in an already highly competitive environment. However, tertiary institutions supported the use of Level 5** for admissions purposes. So, it was recommended that the current system of grading should be retained, subject to further analysis of results and review.

An important feature of assessment under the NSS framework has been the introduction of moderated school-based assessment (SBA) as a component in the public examination.¹⁵ This involves teachers in assessing certain aspects of students' work, e.g. investigations in science, in their own classrooms using guidelines, assessment criteria and exemplars supplied by the HKEAA. The HKEAA also trains teachers in SBA. Assessed work is then submitted to the HKEAA for moderation. In 2012, the first year of the HKDSE, SBA was implemented in arts and humanities subjects, and to a partial extent in biology, chemistry, physics, combined science and integrated science. SBA is thought to have several advantages: it can reflect the development of individual learning over the whole course; it enables assessment of skills difficult to assess through conventional public examination, e.g. laboratory work; and it enables ongoing feedback for students' subsequent learning, i.e. 'assessment for learning.' As with debates about course-work assessment in the UK and elsewhere, the introduction of SBA presented challenges, mainly in terms of the perceived increase in workload for students and teachers, although there were also concerns about drilling for standard assignments. Interestingly, few concerns were expressed about the dependability of results of the SBA component; the majority of

¹⁴ For more detail see: http://www.hkeaa.edu.hk/en/HKDSE/assessment/the_reporting_system/SRR/#generic

¹⁵ Information on this can be found at:

http://www.hkeaa.edu.hk/DocLibrary/Media/Leaflets/SBA_pamphlet_E_web.pdf

schools implemented appropriate procedures, and moderated standards were also found to be generally robust. The Education Bureau appears to remain committed to SBA on educational grounds, although concerns about workload led to recommendations being put in place: cancelling SBA in three subjects, including mathematics; deferring SBA until 2019 in nine subjects; fine-tuning and streamlining SBA in all other core and elective subjects. In science subjects, from 2018, SBA will count for 20% of marks awarded in the HKDSE.

3.6.2. Category B, Applied Learning (ApL) Subjects

ApL subjects are offered by providers of these courses, who also undertake the assessments of these subjects. These are often located in tertiary institutions in Hong Kong. This represents important collaborations between schools and further education and vocational providers. The assessment results are moderated by the HKEAA to ensure consistency in standards. These results are then recorded on the student's HKDSE certificate. Two levels of performance are recorded: 'Attained' and 'Attained with Distinction.' The latter is deemed to be equivalent to performance at Level 3 in Category A subjects. 'Unattained' performance is not recorded on the HKDSE certificate.

3.6.3. Category C, Other Language Subjects

The six Other Language Subjects are examined through the Advanced Subsidiary (AS) Examination of Cambridge International Examinations (CIE) but administered by HKEAA. Marking and grading are conducted by CIE. Results are reported using the current five grades (A-E) used in the UK. Achievement below grade E is not reported in the individual student's HKDSE although 'U' is reported in national statistics.

3.7 University admission requirements and recognition

The minimum entrance requirement for undergraduate programmes offered in Hong Kong is Level 3 for Chinese Language and English Language, and Level 2 for Mathematics Compulsory Part and Liberal Studies. This is known as the '3322' profile. Individual institutions, faculties or programmes then determine the attainment level required for one or more elective subjects. Associate Degree (c.f. UK foundation degrees) or Higher Diploma programmes have a slightly lower entrance requirement, accepting Level 2 in five HKDSE subjects, including English and Chinese. A maximum of 2 ApL subjects at 'Attained' Level can also be accepted.

Securing agreement on admission requirements to universities and post-secondary studies has been crucial for the success of Hong Kong's reform programme. This was achieved only through a lengthy process of deliberation and negotiation.

The HKEAA has also worked closely with international bodies to secure recognition of the HKDES by non-local and overseas institutions. For example, a study of the HKDSE qualification in 2009 by the Universities and Colleges Admission Service (UCAS) in the UK set up a tariff points system for HKDSE results. Points have been awarded from Level 3 to Level 5* in all 24 core and elective subjects.¹⁶ The HKEAA also worked with the UK National Recognition Information Centre (NARIC) to validate and endorse the HKDSE for general education and employment. The 2010 NARIC report indicates that a wide range of competency is covered in the HKDSE, with Levels 3 to 5 emphasising sophisticated application of subject knowledge. Although direct comparisons with the former HKALE are not possible because entrance to the

¹⁶ For detail see: http://www.hkeaa.edu.hk/DocLibrary/IR/UCAS_Factsheet_Eng.pdf

HKALE was restricted to only 30% of the cohort, the NARIC report affirms comparability with standards in the former HK A Level examination.¹⁷ A very important point to note is that, generally, HKDSE examinations are taken by students at the end of Secondary 6, at the age of 17, i.e. one year younger than A Levels taken formerly in Hong Kong and currently in England.

4. Science subjects and skills in the curriculum

The details of the new curricula for all science subjects can be downloaded from the EDB website.¹⁸ These documents were prepared jointly by the CDC and HKEAA and were recommended for first use in 2007, i.e. allowing two years preparation for the first cohort of students to embark on the new senior secondary curriculum. The most recent update was published in November 2015.

4.1 Curriculum guides

The structure and content of these curriculum guides follow a common pattern. Each begins with a clear rationale and aims, and an account of how the senior secondary curriculum interfaces with both junior secondary and post-secondary pathways. The broad aims of the physics curriculum, for example, are given as:

- To develop interest in the physical world and maintain a sense of wonder and curiosity about it;
- To construct and apply knowledge of physics, and appreciate the relationship between physical science and other disciplines;
- To appreciate and understand the nature of science in physics-related contexts;
- To develop skills for making scientific inquiries;
- To develop the ability to think scientifically, critically and creatively, and to solve problems individually or collaboratively in physics-related contexts;
- To understand the language of science and communicate ideas and views on physics-related issues;
- To make informed decisions and judgments on physics-related issues; and
- To be aware of the social, ethical, economic, environmental and technological implications of physics, and develop an attitude of responsible citizenship.

These aims are elaborated and exemplified in the curriculum framework that follows; this gives details of what should be learned (teaching intentions) and what students should be able to do (learning outcomes). The framework makes clear that what is to be learned is more than knowledge and understanding. Skills, processes, values and attitudes are considered to be equally important. However, the curriculum guides do not stop at subject content and learning targets. They also provide substantial advice to schools and teachers on: curriculum planning, e.g. suggested learning sequences, adaptations for learner diversity; pedagogy, e.g. scaffolding, flexible grouping; assessment, e.g. formative and summative; resources, e.g. textbook selection, use of new technologies. What comes over clearly is the extent to which these guides have been informed by the vision, knowledge and experience of professional educators and educational researchers, whilst not ignoring the needs and wishes of the wider community.

¹⁷ See: <http://www.ecctis.co.uk/naric/news%20story.aspx?NewsID=113>

¹⁸ <http://334.edb.hkedcity.net/EN/curriculum.php#01>

4.2 Take-up and performance

As mentioned above, the take up of science subjects has not been seen as a particular problem in Hong Kong (but see comments on gender differences, below). This is reflected in the number of entries as well as results (see Tables 1, 2.1, 2.2 and 2.3). The figures in these tables are taken from HKEAA tables of the results of day school candidates sitting the subjects for the first time, i.e. excluding retakes. Between 2015 and 2017 the total number of HKDSE candidates has declined. This could be taken to reflect the overall declining trend in fertility in Hong Kong around the period – 1998 to 2000 - when these students were born. 59,977 live births were recorded in 1998, 51,281 in 1999, and 54,134 in 2000.¹⁹ In 2001, the number of live births fell back to 48,219 and resumed the declining trend until 2005.²⁰

The fact that the numbers of HKDSE candidates for the examinations in 2015 and 2016 exceeded the numbers of live births for 1998 and 1999, respectively, probably reflects inward migration. But the 9.5% drop in HKDSE entries in 2017 from the previous year is more puzzling. Entries were below the birth rate for 2000, which might indicate increased drop-out from the HKDSE. If true, this must be a cause of concern if Hong Kong is to achieve and maintain its aspiration that the HKDSE should be a qualification for *all* Hong Kong senior secondary school students.

Taking account of the slight fall in overall numbers of candidates since the introduction of the HKDSE, the number of entries for single sciences has remained broadly stable across the three years, although entries for Combined Sciences have fallen more sharply. This may reflect the value attached to single science courses and examinations by universities in Hong Kong and elsewhere. Combined and Integrated Science courses were new under the NSS; they did not exist within the HKALE. It may be the case that candidates are encouraged to take these when they want some science in their profile but do not feel able or motivated to pursue these subjects in further study. But the small, and reducing, numbers may also indicate that these new subjects are struggling to find favour. However, it is not the case that these courses are designed only for students considered 'less able.' If this were the case it would not be possible for students to achieve higher grades in these subjects. The fact that a (very) small proportion achieve Level 5 indicates that the course and the examination provide them with opportunities to achieve highly. The policy of 'high expectations for all' in Hong Kong appears to be justified.

The conclusion that the reforms in Hong Kong have increased access and opportunity for students to pursue senior secondary studies is also supported by a comparison with results from the final three years of the HKALE (see Tables 3.1, 3.2 and 3.3). These provide evidence that the numbers of students entered and 'graduating' with the HKDSE at 17 years of age is approximately double the number who graduated with HKALE certificates at 18 under the old system. Admittedly, this difference is smaller when the single science subjects are considered separately. The number of candidates taking biology has more than doubled, the number taking chemistry has risen by 40%-50%, but those taking physics have increased by only around 10%-20%. This is not entirely surprising because physics is often considered a 'difficult' subject and similar proportions of the cohort, under both systems, are likely to feel confident and able to attempt it. What is more remarkable is the dramatic increase in the percentage of candidates attaining the highest grades.

¹⁹ The slight bounce in 2000 might be a consequence of the ruling of the Court of Final Appeal in July 2001 that babies born in Hong Kong to Chinese nationals, i.e. not Hong Kong permanent residents, have the right of abode in Hong Kong.

²⁰ <http://www.statistics.gov.hk/pub/B71312FA2013XXXXB0100.pdf>

Table 2: Most recent HKDSE science subject results of day school first attempters, i.e. excluding private, boarding and retake candidates

*Table 2.1: Science Subjects – 2015
(Total number of HKDSE candidates = 59,813)*

Subject		No. Sat	Percentage of levels awarded							
			5**	5*+	5+	4+	3+	2+	1+	U
Biology		15,422	1.9	7.6	18.8	44.6	71.5	90.1	97.4	2.6
Chemistry		14,680	2.6	10.5	26.4	51.5	76.2	88.3	96.3	3.7
Physics		11,869	2.8	11.1	27.1	48.9	72.3	89.8	97.9	2.1
Combined Science	Biology + Chemistry	1,370	0.2	0.9	2.4	15.4	44.5	73.6	91.8	8.2
	Biology + Physics	143	0.7	2.1	6.3	14.0	45.5	71.3	88.1	11.9
	Chemistry + Physics	772	0.1	1.0	2.5	15.3	45.7	71.2	89.9	10.1
Integrated Science		165	0.0	0.6	2.4	14.5	42.4	72.7	90.3	9.7

*Table 2.2: Science Subjects – 2016
(Total number of HKDSE candidates = 55,156)*

Subject		No. Sat	Percentage of levels awarded							
			5**	5*+	5+	4+	3+	2+	1+	U
Biology		14,132	2.0	7.8	18.9	44.5	71.3	89.7	97.2	2.8
Chemistry		13,498	2.5	10.3	25.6	52.4	77.0	88.3	96.2	3.8
Physics		11,099	2.6	10.7	26.5	50.6	73.7	90.8	97.9	2.1
Combined Science	Biology + Chemistry	776	0.3	0.6	1.3	11.7	37.4	64.3	88.9	11.1
	Biology + Physics	76	0.0	2.6	2.6	18.4	38.2	73.7	90.8	9.2
	Chemistry + Physics	471	0.4	1.1	5.3	25.7	57.5	78.6	92.8	7.2
Integrated Science		149	1.3	2.7	7.4	22.1	48.3	79.9	94.0	6.0

*Table 2.3: Science Subjects – 2017
(Total number of HKDSE candidates = 52,058)*

Subject		No. Sat	Percentage of levels awarded							
			5**	5*+	5+	4+	3+	2+	1+	U
Biology		13,249	2.0	7.7	19.3	46.2	71.7	90.0	97.0	3.0
Chemistry		12,500	2.7	10.7	26.6	52.3	77.0	88.3	96.2	3.8
Physics		10,293	2.8	11.6	28.9	50.8	72.2	89.7	97.9	2.1
Combined Science	Biology + Chemistry	441	0.0	0.9	1.8	16.1	42.4	72.6	90.7	9.3
	Biology + Physics	46	0.0	2.2	2.2	13.0	47.8	80.4	95.7	4.3
	Chemistry + Physics	359	0.3	0.6	1.9	22.3	45.4	74.4	92.5	7.5
Integrated Science		128	0.8	1.6	7.3	25.0	54.7	85.9	96.1	3.9

Sources: HKEAA Press Releases: Hong Kong Diploma of Secondary Education Examination Results Released. Downloadable from

http://www.hkeaa.edu.hk/en/hkdse/admin/release_of_results/

Table 3: Final three years of HKALE science subject results of day school first attempters, i.e. excluding private, boarding and retake candidates

*Table 3.1: Science subjects – 2009
(Total number of HKALE candidates, all subjects = 28,682)*

Subject	No. Sat	A	B+	C+	D+	E+	F+	U
Biology	6,643	2.7	8.1	19.7	47.3	74.2	92.8	7.2
Chemistry	10,298	3.5	10.4	23.0	48.9	75.1	92.4	7.6
Physics	9,710	4.0	10.8	24.3	50.0	75.0	93.2	6.8

*Table 3.2: Science subjects – 2010
(Total number of HKALE candidates, all subjects = 29,814)*

Subject	No. Sat	A	B+	C+	D+	E+	F+	U
Biology	6,796	2.5	8.5	20.2	46.7	74.9	92.1	7.9
Chemistry	10,887	3.3	10.1	23.7	50.3	76.1	92.6	7.4
Physics	10,172	4.1	11.3	25.1	51.0	76.8	92.8	7.2

*Table 3.3: Science subjects – 2011
(Total number of HKALE candidates, all subjects = 31,002)*

Subject	No. Sat	A	B+	C+	D+	E+	F+	U
Biology	7,259	2.9	9.0	21.1	49.3	77.4	92.5	7.5
Chemistry	11,387	4.0	11.2	24.5	50.7	75.9	92.8	7.2
Physics	10,318	4.7	12.2	25.9	52.1	76.7	92.2	7.8

Additional Sources: HKEAA Press Releases^{21 22 23}

As mentioned above, an extensive international benchmarking exercise established the new HKDSE Level 5 and above as equivalent to Grade A at A Level. Table 4 illustrates the trend that between 16% and 29% of students who enter now attain a Level 5, in at least one single science, in contrast with the 2.5% to 5% who gained a Grade A under the old system. Thus, around a quarter of science candidates in Hong Kong now achieve this higher level. In physics and chemistry the proportion is highest, and rising, but somewhat lower in biology, although also rising.

²¹ http://www.hkeaa.edu.hk/DocLibrary/Media/PR/20110629_HKALE_Results_ENG_FULL.pdf

²² http://www.hkeaa.edu.hk/DocLibrary/MainNews/20100629_HKALE_Results_ENG.pdf

²³ http://www.hkeaa.edu.hk/DocLibrary/MainNews/2009_06_29_HKALE_release_of_results_ENG_full.pdf

Table 4: Percentage of equivalent high levels attained in single science subjects – final 3 years of HKALE compared with the 6 years of HKDSE

	HKALE			HKDSE					
	2009	2010	2011	2012 ²⁴	2013	2014	2015	2016	2017
	A	A	A	5+	5+	5+	5+	5+	5+
Biology	2.7	2.5	2.9	15.7	17.2	17.0	18.8	18.9	19.3
Chemistry	3.5	3.3	4.0	21.0	23.3	25.1	26.4	25.6	26.6
Physics	4.0	4.1	4.7	23.8	26.2	27.2	27.1	26.5	28.9

Further analysis of recent results also indicates that attainments in HKDSE single sciences exceed attainments in other Category A subjects by some considerable margin (see Table 5). Taking the data in Tables 2.1, 2.2 and 2.3, the average percentage of levels achieved across the single sciences was calculated and compared with percentage levels attained for all other Category A subjects i.e. excluding these sciences.

Table 5: Average percentage of HKDSE levels in single science subjects compared with average percentage of levels in all other Category A core and elective subjects, awarded to first attempters

	Percentage of levels attained					
	2015		2016		2017	
	5+	3+	5+	3+	5+	3+
Biology, chemistry and physics	24.1	73.3	23.6	74.0	24.9	73.6
All Category A subjects, excluding single sciences	10.6	55.35	10.8	56.6	11.1	57.8

Sources of data: HKEAA Press Releases: Hong Kong Diploma of Secondary Education Examination Results Released. Downloadable from: http://www.hkeaa.edu.hk/en/hkdse/admin/release_of_results/

It would appear from this evidence that the new science curricula in Hong Kong are popular, and attract candidates for examination who then do well. Achieving a Level 3 and above is generally considered acceptable for entrance to undergraduate programmes in local universities. However, there remain concerns about gender patterns of entry and performance in relation to particular subjects, including the sciences.

²⁴ Tables for 2012 include all day school students, including retakes. No data were given in the press release for first attempters only. Without retakes these numbers might have been slightly higher.

4.3 Gender differences

The report of the Medium-term Review²⁵ notes that: ‘female students, in general do better in language subjects than males, and the gap between females and males in meeting the general requirements for UGC-funded institutions may be due in part to the better performance of females in Chinese and English Languages ... even though males are performing better at Level 5 or more in mathematics and some science subjects’ (p. 60).

As Table 6 indicates,²⁶ females do indeed outperform males in general, and in all four of the core subjects, with the exception of Level 5 in mathematics. In single science subjects, the patterns of performance are not markedly different. Females do a little less well than males at Level 5 in physics and chemistry but their performance is broadly comparable in biology, and they do better than males in ICT.

Any interpretation of these data should, however, take account of entry patterns (see Table 7). For example, about one-third more females than males sat the biology examination in 2016, but approximately one-quarter more males than females sat chemistry, two-thirds more males than females sat physics, and four-fifths more males than females sat ICT. Although those females who took these subjects did well in them, the extent of their participation in science in the senior secondary curriculum, especially ICT, must be a cause for concern.

This has been a familiar pattern in other countries and at other times. For example, similar patterns were noted in a review of research on gender and educational performance carried out in 1998 by Cambridge University for the UK Office for Standards in Education (Ofsted).²⁷ This drew attention to evidence of a highly selective female entry for physics indicating that females who choose subjects such as physics are very able and highly motivated.²⁸ But there are too few of them. A key issue in Hong Kong, as elsewhere, is how to tackle the continuing problem of gender-stereotyped choices of elective courses in upper secondary education. This is not only a problem for schools but also for the wider community, including universities, employers and the media. It is undoubtedly linked to attitudes towards science and perceptions of STEM-related careers.

²⁵ http://334.edb.hkedcity.net/doc/eng/MTR_Report_e.pdf

²⁶ Data on gender differences in patterns of performance and attainment in the HKDSE 2017 were not published at the time of writing.

²⁷ Arnot, M., Gray, J., James, M. and Rudduck, J., with G. Duveen, (1998) *Recent Research on Gender and Educational Performance*, (OFSTED Reviews of Research series) London: The Stationery Office.

²⁸ The Ofsted review also noted this ‘cross-over pattern’ with respect to males who took post-16 courses in literature, languages and history.

Table 6: Day school candidates' performance in the HKDSE, by gender, in core and science subjects, 2014-2016

Subject	Gender	Level 5+			Level 3+			Level 2+		
		2014	2015	2016	2014	2015	2016	2014	2015	2016
Chinese Language	Male %	5.3	5.0	5.4	43.1	43.3	44.3	74.3	75.6	78.9
	Female %	10.6	10.2	13.4	60.7	60.0	66.6	86.6	88.2	91.6
English Language	Male %	7.3	6.4	7.7	45.8	45.8	48.7	72.2	73.5	74.7
	Female %	12.7	11.3	13.1	59.7	59.0	61.5	83.7	85.1	85.9
Mathematics (compulsory Part)	Male %	15.8	16.4	15.6	58.7	59.1	58.2	80.3	81.2	80.6
	Female %	10.4	12.0	12.0	57.0	60.1	58.9	79.7	82.4	82.1
Liberal Studies	Male %	6.5	6.9	6.1	59.1	57.0	59.2	83.8	82.4	85.3
	Female %	12.1	14.4	12.3	74.0	74.7	76.4	91.7	92.1	93.5
Biology	Male %	18.2	19.3	18.9	68.8	69.7	69.5	88.2	88.9	88.4
	Female %	16.2	18.7	19.0	69.9	73.0	72.8	89.5	91.1	90.8
Chemistry	Male %	26.4	27.8	27.0	75.7	76.1	76.5	86.6	87.7	87.2
	Female %	23.5	24.6	24.0	76.5	76.5	77.6	88.0	89.0	89.6
Physics	Male %	28.2	28.2	27.1	73.4	71.8	73.4	89.7	89.0	90.3
	Female %	24.9	24.2	25.0	74.8	74.0	74.9	92.1	92.0	92.2
ICT	Male %	6.8	7.6	7.8	46.9	48.8	50.9	76.5	77.2	79.7
	Female %	7.7	7.1	8.1	51.1	51.4	53.7	80.6	79.8	83.0
All Cat. A subjects	Male %	11.1	11.2	11.1	55.3	54.9	56.1	86.1	80.0	81.4
	Female %	12.5	13.2	13.9	64.4	65.3	67.1	86.1	87.4	88.6

Sources: HKEAA ^{29,30, 31}

²⁹ www.hkeaa.edu.hk/DocLibrary/HKDSE/.../dseexamstat14_5.pdf

³⁰ www.hkeaa.edu.hk/DocLibrary/HKDSE/.../dseexamstat15_5.pdf

³¹ www.hkeaa.edu.hk/DocLibrary/HKDSE/.../dseexamstat16_5.pdf

Table 7: Numbers of day school candidates who sat single science subjects in the HKDSE, by gender, 2014-2016

Subject	Gender	2014	2015	2016
Biology	Male	6 835	6 321	5 804
	Female	9 266	9 374	8 518
Chemistry	Male	8 513	8 102	7 301
	Female	6 852	6 844	6 365
Physics	Male	9 215	8 752	8 149
	Female	3 652	3 354	3 089
ICT	Male	5 068	4 579	4 441
	Female	1 815	1 598	1 361
All Cat. A subjects	Male	191 439	177 902	164 117
	Female	192 575	181 177	165 001

Sources: HKEAA, as Table 6

The Short- and Medium-term Reviews of the NAS carried out by the Hong Kong EDB, HKEAA and CDC reported nothing explicitly on attitudes to science. However, a recent study of 350 Hong Kong students from Secondary 3 (end of junior secondary) investigated gender differences in attitudes to science.³² Male students demonstrated significantly more positive attitudes towards science in five dimensions i.e. self-concept in science, enjoyment in science, learning science in and outside the classroom, and future participation. Moreover, the school bands in which students were placed played a prominent moderating role in gender differences in students' attitudes towards science.

Cognisant of both successes and issues of concern, the Government in Hong Kong is far from complacent. In March 2017, all secondary schools were sent a circular memorandum inviting them to apply for grants of HK\$200,000 (equivalent to about 20,000GBP) per school, to be spent by August 2019, to enhance their provision for STEM subjects. The stated rationale is:

In the 2015 and 2016 Policy Addresses, the Government pledged to promote STEM education with a view to nurturing students' learning interest, enhancing their creativity, collaboration and problem solving skills as well as developing their innovativeness. Furthermore, students are encouraged to pursue the

³² Wan Z.H & Lee C. K. (2017) 'Hong Kong secondary school students' attitudes towards science: a study of structural models and gender differences', *International Journal of Science Education*, <http://dx.doi.org/10.1080/09500693.2017.1292015>

study of STEM-related subjects and relevant careers in the future for the sustainable development of Hong Kong. In this regard, the Education Bureau (EDB) is taking actions to promote STEM education among schools in a holistic and coherent manner, including updating the relevant curricula, enriching students' learning activities, providing suitable learning and teaching resources, and enhancing teachers' professional development.³³

5. Evidence of the impact of the broad nature of the curriculum on student outcomes

The first students to receive a HKDSE certificate left secondary school in 2012. Those progressing to the new four-year undergraduate courses graduated in 2016. As yet, only limited information about their subsequent pathways is available and, at the time of writing, it is difficult to assess the full impact of these changes on the labour market and post-graduate trajectories. To date, the best source of evidence on the impact of the NSS reforms on students is found in the report of the CDC/HKEAA/EDB's Medium-term Review, *Continual Renewal from Strength to Strength*, published in November 2015.³⁴ (Much of the evidence given below is drawn from this report.) This report was the culmination of a wide-ranging review conducted after four cycles of the NSS and HKDSE. It is mostly based on an internal evaluation, but with external advice, involving analysis of national and international outcome data, and surveys, interviews and focus groups with a wide range of stakeholders. Chapter 4 of the report focuses specifically on the impact of the reforms on students. It examines the impact on their senior secondary education, further studies and employment.

5.1 Impact on the senior secondary education of students

The report emphasises that achievement of the seven learning goals (see Section 3 of this case study) was the major intended outcome of secondary education under the NAS. In an implementation survey, well over 50% of students, teachers, panel heads and school principals agreed that these learning goals had been achieved although they were least positive about students' development of a global perspective and a sense of national identity. Perhaps this is not entirely surprising because issues around the teaching of national identity created controversy in Hong Kong (Morris & Vickers, 2015³⁵).

Liberal Studies has attracted similar attention. The Medium-term Review indicates that this core subject has been an important means of developing students' generic skills of critical thinking and independent learning, and broadening their perspectives and knowledge. For these reasons it has become highly valued by students and teachers, confirmed by independent studies (Fung & Lui, 2016³⁶). Although the students and teachers in their study denied it, Fung and Lui refer to claims that Liberal Studies was used as a political instrument to instigate students' participation in the protest movement of 2014. The author of this present case study visited Hong Kong in November 2014, during these protests, known as the Occupy Central or

³³ <http://applications.edb.gov.hk/circular/upload/EDBCM/EDBCM17068E.pdf>

³⁴ http://334.edb.hkedcity.net/doc/eng/MTR_Report_e.pdf

³⁵ Morris, Paul and Vickers, Edward (2015) Schooling, politics and the construction of identity in Hong Kong: the 2012 'Moral and National Education' crisis in historical context. *Comparative Education*. <http://dx.doi.org/10.1080/03050068.2015.1033169>

³⁶ Fung, Dennis Chun-Lok and Lui, Wai-Mei (2016) Is Liberal Studies a political instrument in the secondary school curriculum? Lessons from the Umbrella Movement in post-colonial Hong Kong. *The Curriculum Journal*. <http://dx.doi.org/10.1080/09585176.2016.1275727>

Umbrella Movement. Students were protesting about the decision by the Standing Committee of the National People's Congress in Beijing to rule out full universal suffrage in Hong Kong. It was clear to the author that some of those opposed to this protest placed some of the blame on the LS curriculum and its encouragement of critical thinking around 'issues'. More generally, however, it illustrated the ongoing tensions between pro-China and pro-democracy factions in Hong Kong with which the designers of the new curriculum had to contend. In order to build consensus, they had to tread a careful course through this minefield by listening, negotiating, consulting and communicating every step of the way.

As mentioned above, the impact of the NSS on students' results in the HKDSE has been more than satisfactory. For example, in 2015, 2016 and 2017 over 40% of day school candidates met the entrance requirements for university admission in Hong Kong – something that was simply not possible under the old selective system.

In 2012, Hong Kong had the interesting and challenging experience of having two cohorts of students undergoing examination and starting university at the same time. The cohort of 18 year olds, following the former HKALE, was being examined and leaving school at the same time as the cohort of 17 year olds was taking the HKDSE under the new NAS. In that year there were 18,302 candidates for the HKALE compared with 26,515 day-school candidates for the HKDSE, an indication of broadening access to SS qualifications - a trend that has continued.

In terms of international comparisons, the OECD's 2012 PISA Study was the first to test 15 year-old students under the new NAS. The results suggested³⁷ that with the broader and more balanced curriculum, the high levels of student achievement in Hong Kong had been maintained both in terms of country ranking and in mean scores (see Table 8). Of the 65 participating countries, Hong Kong was positioned third in mathematical literacy, second in scientific literacy and second in reading literacy. It should be noted, however, that since these are tests of 15 year olds, who would not have experienced the full range of knowledge and skills in the NSS at the time when they were tested, any claims about impact on PISA results need to be treated with caution.

In PISA 2015, involving 72 countries, Hong Kong retained its second place in reading, and improved its position to second in mathematics. Worryingly, however, mean scores had reduced across the three subject areas and Hong Kong had dropped to ninth place in science rankings. Several reasons have been advanced for this. The PISA assessment had changed to a computer-based one, which may have put Hong Kong students at a disadvantage because ICTs were not as widespread in Hong Kong schools as elsewhere, for example, Singapore. Another suggestion is that, under the new system, it is now unusual for students to take all three sciences (only 4.41% do this) whereas under the old system, of arts and science streams, 40% took three separate sciences. Whatever the reason, this situation is likely to have been a stimulus for the additional resources offered to schools by the Government in 2017 to support STEM subjects (mentioned in Section 4 above).

³⁷ <http://www.info.gov.hk/gia/general/201312/03/P201312030421.htm>

Table 8: PISA results: mean scores and rank

	Reading Literacy		Mathematical Literacy		Scientific Literacy	
	Mean score	Rank	Mean Score	Rank	Mean Score	Rank
2015	527	2	548	2	523	9
2012	545	2	561	3	555	2
2009	533	4	555	3	549	3

5.2 Further studies and employment

Over the 3-year period of the Medium-term Review, more than 85% of Secondary 6 students progressed to further study. In 2014, 34% of students enrolled in bachelor degree programmes in Hong Kong. Others progressed to university degree courses in other countries. In 2014, 903 students were accepted at UK universities, 1542 in Taiwan (now the most popular destination), 914 in Mainland China, 509 in Australia, 314 in the USA, 189 in Canada, and 293 elsewhere.

A Graduate Impact Survey carried out for the Medium-term Review provided evidence that two-thirds of respondents were positive about the impact of their SS subjects on their further studies. English Language was judged to have the greatest impact although responses were positive for all core subjects. Most respondents agreed that Liberal Studies enhanced thinking skills. However, some students commented that excessive drilling for the HKDSE examinations had hindered development of their self-directed learning, which they considered crucial for post-secondary study.

In ‘sharing sessions’ with academics and registrars from tertiary institutions, the Medium-term Review was given evidence that students had made successful transitions from secondary education. Communication skills, a readiness to speak up and to express opinions, was mentioned especially. Anecdotally, the author of this case study was told, during a visit to Hong Kong University in November 2012, that although the new entry of 17 year old HKDSE ‘graduates’ were physically smaller than the 18 year old HKALE ‘graduates’, who had entered together that term, it was noticeable that the younger cohort of students was more active, engaged, and ready to question. However, the Medium-term Review reported that some academics and registrars, especially those in the fields of science and engineering, noted some limitations in HKDSE graduates’ knowledge base, such as core competences in mathematics and breadth of knowledge in science. In the context of significant increases in the number of students taking science subjects (see above) there is a risk of non-negligible decreases in the average academic quality of students. As might be expected, there is a ‘trade off’ here that needs to be considered. The educational reforms are focused on broadening and deepening all students’ all-round experience and achievements. Inevitably this presents challenges to the maintenance and growth of academic excellence that had previously focused on an elite.

About 8% of the cohort, in 2014, entered the workforce directly, rather than continue their studies. According to an exploratory survey, in 2014, of the opinions of 173 employers, school leavers had met or exceeded their requirements for key skills for the workplace. They were positive about language proficiency, numeracy, generic skills and attitudes, but there were some concerns about problem-solving skills and perseverance. On the whole, however, Secondary 6 school leavers were said to be more pro-active, inquisitive, out-going and adaptable – qualities that have sometimes been regarded as lacking in more passive East Asian students. It remains to be seen

how employers evaluate the strengths and weaknesses of graduates from both secondary and tertiary education under the NAS because the latter are only now seeking employment.

5.3 Stress

The Medium-term Review appears not to have explicitly explored unintended consequences of the introduction of the NAS. There is therefore no mention of stress experienced by students. However, a spate of student suicides, in the 2015-16 school year, prompted the EDB to set up a Committee on Prevention of Student Suicides (CPSS), which was tasked to examine the possible causes of recent suicides in Hong Kong and advise on suicide prevention.³⁸ Suicide of students is not unique to Hong Kong; the mental health of young people is equally a problem in UK and elsewhere. Nor is stress necessarily caused by excessive examination pressure. However, records of nine of the 38 'completed' suicide cases of primary and secondary school students in Hong Kong in 2015-16 contained evidence of students' anxieties about their academic performance. Five of these students were found to show unsatisfactory academic performance but the rest had average to excellent academic attainment. The CPSS also noted gender differences in its analysis. Specifically, among the 38 suicide cases of primary and secondary schools, 24 (63%) were males and 14 (37%) were females. Boys outnumbered girls particularly in 2015/16, with a ratio of 14 (74%) boys to 5 (26%) girls. This is consistent with the global trend of males outnumbering females in completed suicides. The committee concluded that subjective perceptions of academic performance might be an important risk factor related to suicidal behaviour.

The broad but challenging NSS curriculum in Hong Kong, in which students study six to eight core and elective subjects, each possibly with the cognitive demand of UK A Levels, can impose considerable pressure on students. Inevitably this can become stressful, particularly perhaps for those with the highest expectations of their own performance. This is something to think about both in Hong Kong, and in other countries when considering this kind of curriculum and assessment model. Its great strengths have to be set against the high workload and attendant pressures, and the potential for perverse unintended consequences.

6. Financial and practical implications of the curriculum model adopted

From 2001, when the Curriculum Development Council first published its recommendations for radical reform, there was widespread community agreement on purposes, and acknowledgement that the implications for the whole system were enormous. Success required very careful preparation, subsequent evaluation and continual renewal. Agreement was secured initially, and throughout, by a great deal of communication and consultation by the Education Bureau using all available means - from 'town hall' meetings to television broadcasts, and lots of print materials. This was seen as necessary because implementation would require coordinated reforms from kindergarten through to higher education, and would involve major changes in curriculum, assessment and examinations, pedagogy, student grouping, the allocation of school places, pathways through higher and vocational education, textbook approval, upgrading of plant, equipment and other resources, quality assurance, and executive guidance and oversight. Above all, there was a need for additional recruitment of teachers and support staff, and a huge investment in

³⁸ The final report can be found at: http://www.edb.gov.hk/attachment/en/student-parents/crisis-management/about-crisis-management/CPSS_final_report_en.pdf

teacher education and training. For example, every school principal attended a four day introductory course. Some of this training was carried out by professionals within the EDB, but much was in association with tertiary institutions such as the Hong Kong Institute of Education (HKIEd). Overseas experts were also recruited for short periods as the need arose.³⁹

None of this could be accomplished without extra money, and it is significant that in 2013, a year of peak activity when two cohorts of first year students were in university at the same time, HKSAR committed 20.3% of government expenditure to education. This compares with the UK Government's 12.9% expenditure in the same year. In 2016 Hong Kong educational expenditure had dropped back to 17%.⁴⁰

In 2013, the CDC/HKEAA/EDB published a Short-term Review report which addressed issues in the implementation of the change.⁴¹ At school level, it highlighted the development of a whole-school approach, which differed from the previous emphasis on the subject-level. From being described as 'examination factories', schools, it claimed, were gradually turning into professional learning communities with participation in curriculum planning, professional sharing and the development of school-based learning and teaching materials with less dependence on textbooks, direct teaching and rote learning.

The majority of teachers were spending more time developing materials to fit students' needs, abilities and interests. However, there were obvious implications for workload, and schools found it challenging to deliver the NSS curriculum in the recommended time of 2,700 hours over the three years. As a direct result of this review, these hours were modified to allow more time for preparation. In response to pressure from some senior school leaders, hours for Other Learning Experiences (OLE) were decreased to 10-15% of total time but elective subjects, including science, retained their allocation of 250 hours each over the three years of SS.

In order to support the NSS curriculum, and especially more student-centred learning, resources were made available to alter classrooms, rearrange the use of space, update equipment, and enrich libraries, especially with e-resources. Human resources also needed attention and teachers were recruited for new subjects or in order to facilitate innovations such as split classes or small group teaching. The EDB sponsored more than 2,500 projects to develop and evaluate new practices. Small class teaching in primary schools, involving researchers from Cambridge University, was one of these.⁴²

The professional development (PD) of teachers was essential to the successful implementation of the reforms and by 2011 virtually all Secondary 6 teachers had participated in PD activities, including sharing good practice with peers from other schools. A Seconded Teachers Strategy had also been used to good effect. This network of seconded teachers, acting as curriculum developers, built a crucial bridge between EDB and schools.

By 2011, the Government had invested more than two billion Hong Kong dollars in additional funding to support the implementation of the NSS. Schools had also made good use of the Diversity Learning Grant, the Quality Education Fund and other

³⁹ Forestier, K. (2011) *Teacher education and education-related studies in relation to Hong Kong*. British Council, Hong Kong.

⁴⁰ <http://data.worldbank.org/indicator/SE.XPD.TOTL.GB.ZS>

⁴¹ <http://334.edb.hkedcity.net/doc/eng/FullReport.pdf>

⁴² [http://www.edb.gov.hk/attachment/sc/edu-system/primary-secondary/applicable-to-primary/small-class-teaching/study_on_SCT_final_report_\(dec2009\).pdf](http://www.edb.gov.hk/attachment/sc/edu-system/primary-secondary/applicable-to-primary/small-class-teaching/study_on_SCT_final_report_(dec2009).pdf)

sources of existing funding and community resources such as the Hong Kong Jockey Club Life-wide Learning Fund.

When the new NAS reforms worked through to tertiary education, universities and other institutions also received additional resources to implement changes. Indeed it was the commitment of funds for new accommodation, equipment and staff that undoubtedly smoothed the transition in 2012-2013 when universities had to cope with the double cohort intake.

Agencies at system level also had to change their practices because the system-wide implementation of NAS and NSS required careful coordination within schools and across sectors of education. Effective support of schools, colleges and universities demanded clear communication and coordination across a wide range of agencies: the Education Commission, CDC, EDB, HKEAA, as well as overseas and mainland agencies. Leadership has been distributed through close collaboration, aided by the fact that Hong Kong's relatively small geographic area made it possible for people to meet together relatively easily. However, during the period of the reforms, an effort was made to streamline the various agencies. For example, the curriculum and the quality assurance wings of the EDB were brought together in one branch under one Deputy Secretary for Education, Dr KK Chan. This promoted joined-up thinking between curriculum developers and school inspectors. It is significant that Dr Chan, an educationalist rather than a bureaucrat, led much of the reform programme from 2000, until her retirement in May 2017. This continuity is remarkable but it has contributed enormously to the coherence and consistency of progressive implementation.

7. Conclusion

Despite long being considered a 'high-performing jurisdiction', HKSAR took the bold decision to change just about everything in order to provide a curriculum for its students more suited to the demands of the 21st century. This involved not only revising curricula and examinations but also restructuring the system and promoting a new vision and purpose with greater attention to the needs of diverse learners and a changing society. Most importantly, it broadened and balanced the curriculum and promoted changes in pedagogy, placing much more emphasis on generic skills of problem-solving, independent enquiry, critical and creative thinking and team work. This approach infused the teaching of STEM subjects as well as newer additions to the curriculum.

Inevitably, this put pressure on teachers and students as the changes were introduced, especially with regard to workload. There was always the risk that things might get worse and that Hong Kong would lose its reputation for excellence. Indeed, newspapers, such as the *South China Morning Post*, often carry articles from critics of the reforms. However, the EDB stayed steadfastly committed to its goals and, fifteen years after the first changes were made, six cohorts of students have graduated from the new system with their Hong Kong Diplomas of Secondary Education. Nothing catastrophic has happened and even the dip in PISA science scores in 2016 might be remedied by the new initiative to enhance STEM teaching and e-resources. Moreover, much is claimed to have been gained in terms of students' broader knowledge, understanding and skills, and enhanced self-confidence and sense of agency.

Other countries can learn a number of lessons from the experience of Hong Kong:

1. ***It is possible to establish a broad and balanced senior secondary curriculum without sacrificing excellence.*** However, there are risks that have to be monitored closely, particularly to prevent the diminution of excellence. Trade-offs have to be negotiated. This needs political will, leadership drive, professional commitment, and the injection of financial and human resources.
2. ***A long-term educational vision matters.*** The fact that Hong Kong first clarified its aims, goals and purposes for the development of the curriculum across all sectors of education, gave the reforms coherence and an essential reference point to keep them on track and focused over a relatively long period of time.
3. ***Continual renewal is essential.*** Whilst the aims and goals remained unchanged, the EDB recognised that implementation needed to negotiate obstacles and respond to new circumstances. So, by developing strategies for on-going data gathering, analysis, evaluation and review it was able to adjust and adapt quickly. 'Continual renewal' has become the mantra as the new system beds down.
4. ***Curriculum change cannot be isolated from changes in other parts of the system.*** Hong Kong recognised that changes in curriculum content and examination syllabuses are, of themselves, not enough. They require accompanying changes in pedagogy and support for students with diverse needs, and these need to be planned and resourced.
5. ***Professional development of teachers is crucial.*** This needs to be properly supported within schools but also by providing opportunities for sharing across schools and the building of professional learning communities.
6. ***Complexity of change at school level has to be reflected in more joined-up thinking and collaboration at system level.*** This is sometimes difficult in larger countries, where agencies are numerous and geographically dispersed. But, as Hong Kong shows, there is a real need for the destruction of silos and better communication and collaboration to ensure coherence across curriculum, assessment, pedagogy and accountability. Securing the agreement and co-operation of the tertiary sector and employers to the changes at school level, for example, with regard to admission requirements, was crucial.
7. ***Regular communication and consultation with all stakeholders needs to be continuous and genuine.*** It was notable that the EDB made consultation with teachers and their unions, parents, employers, politicians, the press, and with students themselves, an important part of established practice. This was time-consuming and often difficult but vital to making any progress.
8. ***Reform needs to be protected from political interference once a path forward is agreed by the community.*** Hong Kong is essentially a one-party state, so a ten-year reform plan was possible. In countries with more layers of democratic accountability, it might be possible to introduce a cross-party advisory body, rather like Hong Kong's Education Commission⁴³, to lay out proposals and to monitor implementation of longer term reforms. This would go some way to counter the turbulence that can be created by frequent changes of government.⁴⁴

⁴³ Or Finland's Board of Education.

⁴⁴ Hong Kong does not escape political interference, however. On 24 June 2017, at a media session, the outgoing Secretary for Education, Mr Eddie Ng Hak-kim, was asked whether he had any regrets after his five years in post. He replied, 'In terms of regrets, actually I do feel we could have done a lot more. But the problem is political interference. It is a regret that we were not being able to make full move of things we should have done in the area of education.'
<http://www.info.gov.hk/gja/general/201706/24/P2017062400373.htm?fontSize=1>

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