

**For Discussion on
9 June 2014**

**Legislative Council Panel
on Information Technology and Broadcasting
Enriched IT Programme in Secondary Schools**

Purpose

This paper seeks Members' support of the proposed Enriched IT Programme in Secondary Schools.

Background

2. Embedded in practically all economic sectors, IT is a major driving force for continuous social and economic developments, underpinning innovation, competitiveness and long-term prosperity. According to the manpower survey of the IT sector conducted by the Census and Statistics Department in 2012, there were over 78 000 IT practitioners in Hong Kong. The manpower of IT sector grew by 18 percent from 2008 to 2012, which was among one of the fastest growing sectors. With increasing development of IT in almost all spheres of economic activity, we can expect an increase in the demand for IT talents in all respects: as programmers, system analysts and designers, IT architects and engineers, IT security specialists and auditors, innovators and technopreneurs.

3. Schools are the best ground to scout and develop IT talents. Early exposure coupled with intensive training on logical thinking and creative problem solving in students' formative years is conducive to nurturing them into innovative and capable IT professionals and tech entrepreneurs. In recent years, many places are making IT studies a rigorous academic discipline in the secondary curriculum, and some advanced economies have set up special secondary schools to groom IT talents through collaboration with the IT industry and tertiary institutions. A brief summary of these reference cases is at **Annex A**.

4. In Hong Kong, Computer Literacy (CL) is a mandatory subject in the junior secondary curriculum to develop students' computer literacy with an understanding of fundamental concepts of computers. For senior secondary, Information and Communication Technology (ICT) is one of the Hong Kong Diploma of Secondary Education (DSE) elective subjects. In 2013, about 7 900 candidates (9.7% of total) took ICT in the DSE Examination. In comparison, there were significantly more candidates taking other science subjects such as Physics (18.7%), Chemistry (21.2%) and Biology (22.0%).

5. Given the many competing academic and career disciplines, students with IT talents may not choose to pursue IT in senior secondary and in tertiary education. However, there is an increasing demand of IT talents and professionals. According to the above 2012 manpower survey, we need about 2 900 IT degree graduates and 1 800 IT sub-degree graduates joining the IT industry every year. The relatively small pool of secondary students showing interest in IT may not be conducive to the sustainable development of IT manpower for Hong Kong.

6. Early exposure and interest nurturing through interesting and practical IT training is one method to keep these students' continuing interest in the subject. Through participating in project-based learning and competitions, students can appreciate the creative nature and versatility of computing in everyday lives. There are many examples of renowned IT talents around the world who were inspired at a young age and soon became leading figures in the IT sector. To identify such gifted young people earlier, the Financial Secretary announced in the 2014-15 Budget that we plan to incorporate enrichment programmes in secondary schools which are outstanding in IT education. By so doing, we hope to cultivate young IT professionals and even entrepreneurs to meet the development needs of a digital society.

Enriched IT Programme

7. We propose to implement, on a pilot basis, a two-pronged Enriched IT Programme in Secondary Schools (Programme) starting from the 2015/16 school year for eight years until 2022/23. The proposed Programme comprises two elements —

- (a) enriched IT classes (IT Class) in up to eight selected secondary schools (partner schools) to provide intensive IT training to students who are interested and talented in IT; and

- (b) enriched IT activities (IT Activities) to be organised by other secondary schools to foster a pro-IT atmosphere in the school community.

IT Class

8. We propose to select up to eight partner schools which will set aside one class of normal size in each form from Secondary 2 to Secondary 6 for more intensive IT training. While IT Class students will study the school curriculum alongside their peers in other classes, they will devote 2 - 3 extra hours a week for a more structured and advanced IT curriculum, seasoned with professional exposures and project-based learning to develop their computational thinking, problem-solving ability, creativity and innovative talents. The advanced IT curriculum will be jointly developed by the partner schools, tertiary institutions, IT professional bodies and renowned IT industry corporations.

9. IT Class students will gain more in-depth and technically advanced IT knowledge as well as relevant project-related experience and exposure. Some if not all, are expected to be able to attain industry recognised certificates such as Java Programming, Cisco Certified Network Associate, Oracle Database Administration. If they choose to pursue a vocational career, i.e. not attending post-secondary studies, they can readily join the employment market; if they pursue post-secondary studies, they would have a certain edge over the others. Either way, the pool of IT practitioners and talents would be enlarged.

10. Having gone through such structured and focused training and with hands-on experience at an early age, the potential of these students would be better realised and it is more likely that they would have a continuing interest in the subject as they pursue further studies or embark on their careers. They would be proficient in computational thinking and capable of using such ability to innovate at a young age, which would enable them to move further and faster with higher achievements in their studies and careers.

11. The proposed learning targets for IT Class students are set out at **Annex B**.

Partner Schools

12. The partner schools will be tasked to provide intensive training to the IT classes according to a custom-designed curriculum (paragraph 8 above refers), and organise IT activities for the benefit of IT class students as well as students from other schools. The support of the tertiary institutions, IT professional bodies and renowned IT corporations would be enlisted to devise the curriculum, undertake collaborative teaching, and arrange internship and exposure opportunities. In view of the intensive commitment and heavy involvement of industry bodies and tertiary institutions, we propose to confine the number of partner schools to a manageable size of, say, five to eight.

13. All local secondary schools will be invited to submit proposals. There will be an evaluation and selection process and the following criteria would be adopted —

- (a) track record in organising or participating in IT activities (e.g. seminars, IT and informatics competitions, exposures to IT facilities and companies, etc.);
- (b) availability of ICT subject for Hong Kong Diploma of Secondary Education (HKDSE) and the ICT academic results;
- (c) school's IT curriculum and pedagogy;
- (d) school's IT facilities;
- (e) school's IT teaching team; and
- (f) track record in sharing of IT teaching resources and experiences.

14. We propose to start the IT Class from Secondary 2. This would allow time for new Secondary 1 students to settle in the new secondary school learning environment and allow the partner schools to observe and to scout out students with interest and talents in IT. Furthermore, partner schools which have the capacity and whose students have the ability to cope with a more advanced IT curriculum at HKDSE years would also be able to start with Secondary 4 in tandem with Secondary 2 when we roll out the Programme in the 2015/16 school year. This arrangement will ensure that higher form students with interests and talents would not be missed out.

15. We expect professional IT teachers to take charge of the IT Classes. They will also be responsible for administering and organising activities for the IT Classes and serve as mentors for IT Class students.

16. To make optimal use of IT Class resources to benefit more students, each partner school will have to run at least three IT activities each year for students in other schools.

IT Activities

17. For the school community as a whole, to create a pro-IT atmosphere and stimulate interest, we would encourage interested schools to organise enriched IT activities for secondary students. Such activities would aim at enriching IT learning outside subject-based curriculum and providing opportunities for applying IT knowledge and nurturing creativity through IT or IT related activities such as short-term intensive programmes to prepare students for IT competitions, coding and programming workshops outside normal school curriculum, IT projects or hackathon, short courses in apps development, seminars in business intelligence, those akin to ‘sand-box’ concepts of simply allowing students to design their own solutions, etc.

18. All schools would be invited to submit applications to organise enriched IT activities. Interested schools may partner with tertiary institutions, industry bodies or commercial organisations. We expect to fund up to 30 activities a year. Each proposal will be granted up to HK\$50,000.

Programme Monitoring and Review

19. A Steering Committee would be set up to advise, coordinate and monitor the implementation of the Programme, including IT Class and IT Activities. It will draw up the curriculum, advise on the IT activities to be funded under the programme, and enlist commitment from relevant organisations to make the Programme more effective.

20. As the two-pronged Enriched IT Programme in Secondary Schools is a novel arrangement, we will review its outcome and effectiveness in 2017-18, i.e. after implementation of the Programme for two years, and again in 2020-21 to shed light on the way forward.

Financial Implications

21. We estimate that a non-recurrent commitment of around \$75 million is required to implement the nine-year programme from 2014-15 to 2022-23 for the five-year IT Classes for four cohorts starting from the 2015/16 school year, comprising —

- (a) \$16,000,000 for provision to partner schools for acquiring, upgrading, maintaining and operating IT facilities to support the teaching and learning of a more intensive and advanced IT curriculum from 2014-15 to 2022-23;
- (b) \$34,000,000 for provision of class grants to partner schools for eight school years from 2015/16 to 2022/23 for administering IT Classes, with the assumption that two partner schools will also start at Secondary 4 in addition to Secondary 2 in 2015/16;
- (c) \$19,000,000 for supporting IT Activities, as well as promotion and sharing of deliverables of IT Class and Activities such as the teaching materials among the school community and interested stakeholders from 2014-15 to 2022-23; and
- (d) \$6,000,000 for necessary upgrading and addition of IT facilities, equipment, software and services in tandem with technological advancement during the relevant period.

Consultation

22. In March and April 2014, we organised five consultation and exchange sessions with relevant stakeholder groups including the school councils, IT teacher associations, tertiary institutions, IT professional bodies and IT industry corporations on the proposed implementation arrangements. While there was broad support for the Programme, there were concerns over the small number of partner schools. There were also other comments that student talents were scattered and it would be difficult to ensure that they all end up in the partner schools and the establishment of one single IT school may also be considered.

23. In view of the intensive resources and commitment in terms of suitable IT teachers and heavy involvement of industry bodies and tertiary institutions in the form of, say, collaborative teaching, industry-led training modules, practicums and internships, etc., it would be more pragmatic to keep the number of partner schools to a manageable number of five to eight.

Way Forward

24. Subject to Members' views, we will seek funding approval for the implementation of Programme from the Finance Committee.

**Office of the Government Chief Information Officer
Commerce and Economic Development Bureau
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Overseas Experience

United States

Academy of Information Technology (AOIT)

In the United States, the National Academy Foundation in 2000 launched the Academy of Information Technology (AOIT) in 12 high schools with support from major telecommunications providers and ICT corporations including AT&T, Alcatel-Lucent, Verizon, Hewlett-Packard Company, Oracle Corporation, and United Technologies Corporation. At present, there are over 100 academies in different parts of the States.

2. The AOIT curriculum provides high school students (Grades 9 - 12, which is equivalent to Hong Kong's Secondary 3 - 6) with a series of career exploration courses, which use project-based learning techniques with an emphasis on strengthening literacy, project management, leadership, and team building skills while fostering creativity and innovation. The curriculum is vetted by industry professionals to ensure that the content is current and relevant. Academy graduates complete universities faster, earn more, and have stronger ties to their communities than their peers.

3. Crooms AOIT in Florida is one of the most distinguished public high schools. It has become a dedicated magnet school that provides innovative teaching and learning in a technology-enriched environment, engaging students in an academically challenging curriculum so as to prepare them for post-secondary education with industry validated technology skills. In addition to graduating with a regular high school diploma and a National Academy Foundation Certificate, every student will also attain a wide variety of industry recognised IT certifications. It has close connection with leading IT companies.

4. Another AOIT, the Union County AOIT in New Jersey, a public high school, specialises in both information technology and business. Students are selected based on their grade point average attained in Grade 7 and Grade 8 examinations and assessments on Mathematics & Reading Comprehension, and Writing Skills. This AOIT offers students the opportunity to attain industry recognised certifications such as Microsoft Office Specialist, CompTIA A+ Certification, Oracle Database Programming and Oracle Java Programming. Through an agreement with the New Jersey

Institute of Technology (NJIT), students can earn college credit and continue their education at NJIT after graduation. Its graduates are accepted by a number of renowned colleges and universities such as Princeton University and University of California.

Pathways in Technology Early College High School (P-TECH) in New York

5. P-TECH is a career and technical education and STEM (science, technology, engineering and math) public school that weaves high school and college curriculums into a six-year program (Grades 9 - 14 comprising four years of high school and two years of college) tailored for a career in the technology industry. It is a collaborative effort with the New York City Department of Education, City University of New York, New York City College of Technology and IBM. There is no academic screening for admission. Students will work towards an associate degree in applied science in computer systems technology or electromechanical engineering technology. IBM has promised P-TECH graduates preferential hiring upon graduation.

Academy for Software Engineering (AFSE) in New York

6. AFSE is a public high school (Grades 9 - 12) designed to meet the need for computer programmers as the tech industry expands in New York City. There is no academic screening for admission. A Career and Technical Education (CTE) certificate will be awarded upon graduation. AFSE has connections with companies like Google, eBay, Facebook and FourSquare with members from these companies to serve as student mentors and provide internships to students.

United Kingdom

7. In the United Kingdom, Mathematics and Computing Colleges were introduced in 2002 as part of the Government's Specialist Schools Programme in secondary colleges. These colleges are expected to disseminate good practice and share resources with other schools and the wider community. At present, there are about 200 Mathematics and Computing Colleges.

8. The Broadoak Mathematics and Computing College in North Somerset is a high performing specialist Maths and Computing School (Key Stage 4 - 5, which is equivalent to Hong Kong's Secondary 4 - 7). Students at Key Stage 4 (Secondary 4 - 5) will be required to study for the Edexcel Diploma in Digital Applications as well as the Business and Technology Education Council Certificate in IT. Students acquire current, relevant and up-to-date knowledge of ICT which would give them a competitive edge when entering higher education and the employment market.

Australia

9. Hamilton Senior High School is a comprehensive public school (Year 8 - 12, which is equivalent to Hong Kong's Secondary 2 - 6). It won the Western Australian Top Public Schools Award for five of the last six years. Its Specialised ICT course for Year 8 - 10 students is accredited by the Western Australia Department of Education. Students of this course will be able to explore a diverse range of career pathways and access direct links to industry standard courses. Hamilton works in partnership with Murdoch University, Challenger TAFE and Communications and Design Management (CDM) Australia with arrangement to allow students to access online resources of these institutions and to enhance their ability to gain entry into tertiary institutions.

Proposed Learning Targets for Students of Enriched IT Classes

Junior Secondary (S2 – S3) IT Class

1. The learning targets of junior secondary IT Class are to develop students' interest, curiosity and aptitude in IT, and capability and capacity in problem solving, logical reasoning and abstraction, and innovation and creativity. Students will take part in programming projects and application development to practise coding, fundamental logic, abstraction and problem solving skills, as well as industrial visits to enterprises with excellent application of IT to broaden their horizon.
2. After two years of junior secondary education, IT Class students are expected to attain IT certifications related to programming and animation, desktop, mobile and digital media operation commonly recognised by the IT industry such as SQL Programming, Microsoft Office Specialist and Adobe Certified Associate. They will have a strong foundation for further development in IT.

Senior Secondary (S4 – S6) IT Class

3. After Secondary 3, students in the IT Classes are encouraged to take ICT for their Hong Kong Diploma of Secondary Education (HKDSE) or IT courses offered by other institutions (e.g. advanced or credit-bearing courses). As they have received vigorous IT training while in junior secondary, we expect them to be able to handle the HKDSE ICT curriculum with ease, leaving ample capacity to develop technical and business competencies required for further IT professional education or participation in the IT industry.
4. Students will learn advanced concepts and techniques related to writing programs and developing software. They will work with multiple levels of abstraction and implement algorithms in different programming languages. They will develop application systems to deliver practical business solutions, while capable of manipulating different computational artifacts including music, images, visualisations, textual and numerical data. In Secondary 6, training will be more focused on communication and collaboration abilities in a broader business and industrial context.

5. The learning targets of senior secondary IT Class are to develop their higher order thinking, logical reasoning and abstraction, problem solving skills, creativity and competencies in integrating technological know-how with business requirements. Students will be given a diversified menu of learning activities such as –

- (a) Hands-on and project-based learning in software design, visual and digital design, application development, networking and infrastructure, and applications of IT in geographic information system, business intelligence and data analytics, etc., to develop authentic problem-solving abilities;
- (b) Participation in major local and international IT and robotic competitions such as the Asia Pacific ICT Alliance Awards (APICTA), the International Olympiad in Informatics (IOI), the IT Challenge, the Infomatrix and the FIRST Robotics Competition to stretch their creative and innovation talents and to develop their leadership and entrepreneurial skills; and
- (c) Internship and placement opportunities tailored around students' interests to understand the IT profession and careers.

6. Graduates are expected to have in-depth and technically advanced IT knowledge, as well as relevant project-related experience and exposure. Some if not all, are expected to be able to attain industry recognised certificates such as Java Programming, Cisco Certified Network Associate, Oracle Database Administration. If they choose to pursue a vocational career, i.e., not attending post-secondary studies, they can readily join the employment market; if they pursue post-secondary studies, they would have a certain edge over the others.

7. Having gone through such structured and focused training and with hands-on experience at an early age, the potential of these students would be better realised and it is more likely that they would have a continuing interest in the subject as they pursue further studies or embark on their careers etc. They would be proficient in computational thinking and capable of using such ability to innovate at a young age, which would enable them to move further and faster with higher achievements in their studies and careers.