

For discussion
on 14 December 2015

Legislative Council Panel on Education

Consultation on the Promotion of STEM Education

Purpose

This paper briefs Members on the consultation about the promotion of STEM education formally launched by the Curriculum Development Council (CDC) in early November 2015 and the initial feedback from stakeholders.

Background

2. To implement the measures stated in the 2015 Policy Address, EDB will renew and enrich the curricula and learning activities of Science, Technology and Mathematics, and enhance the training of teachers, thereby allowing primary and secondary students to fully unleash their potential in innovation.

3. To maintain the international competitiveness of Hong Kong, a range of talents with different capabilities and at different knowledge and skill levels are required to fulfill the needs of economic, scientific and technological developments in the contemporary world, especially when opportunities arise for Hong Kong to contribute to major initiatives for national developments.

4. STEM is an acronym that refers to the academic disciplines of Science, Technology, Engineering and Mathematics collectively. The STEM concept which covers different domains such as education, industry and economy was first proposed by the National Science Foundation of U.S.A. in the 1990s. For this, Hong Kong has already acquired some successful experiences in school education (please refer to paragraphs 5 and 6). The promotion of STEM education in Hong Kong aligns with the worldwide education trend of equipping students with the capability to meet the changes and challenges in society and around the world with rapid economic, scientific and technological developments. The promotion of STEM education is introduced as one of the key emphases under the ongoing renewal of the school curriculum. Apart from nurturing students to become effective lifelong learners equipped with appropriate knowledge, generic skills as well as values and attitudes necessary for facing challenges in the 21st century, it could also enhance students' interest in science and technology, and identify talents that can fulfill the needs

of the changing scientific and technological development in Hong Kong, the Mainland and neighbouring regions.

5. Hong Kong students have generally performed well in science, technology and mathematics over the years as revealed from international studies (e.g. PISA, TIMSS) and competitions (e.g. International Junior Science Olympiad, Intel International Science and Engineering Fair). On the whole, they actively participate in a wide range of learning activities related to STEM disciplines inside and outside schools nowadays. While Hong Kong students perform well in science, technology and mathematics, they may focus on disciplinary studies and may not evenly participate in hands-on activities in schools. Therefore, it is necessary to strengthen the ability of students to integrate and apply their knowledge and skills across different subject disciplines by encouraging students to solve daily life problems with practical solutions and innovative designs.

6. Although the elements of STEM education are embedded in individual Key Learning Areas (KLAs) of Science, Technology and Mathematics Education of the local school curriculum, the coherence and collaboration among teachers of the three KLAs in planning and coordinating STEM related learning activities need to be strengthened. The promotion of STEM education provides a good opportunity for teachers of these KLAs to collaborate and further enhance the effectiveness of learning and teaching.

7. When promoting STEM education, reference has also been made to the local, the Mainland and international experiences, and the global educational trends of helping students to master appropriate knowledge and skills so as to cope with the changes and challenges in society and around the world.

Aim and Objectives of Promoting STEM Education

8. When formulating the aim and objectives of promoting STEM education in Hong Kong, considerations have been made on the relevant guiding principles as recommended by the CDC. (Annex 1 refers). The promotion of STEM education in schools of Hong Kong aims to strengthen the Science, Technology and Mathematics Education as Key Learning Areas, to nurture diversified talents in the science and technology fields for enhancing the international competitiveness of Hong Kong.

9. The specific objectives of promoting STEM education include:

- To develop among students a solid knowledge base and to enhance

their **interests** in Science, Technology and Mathematics for further studies and careers in meeting the changes and challenges in the contemporary world;

- To strengthen students' ability to integrate and apply knowledge and skills, and to nurture students' creativity, collaboration and problem solving skills, as well as to foster their development of innovation and entrepreneurial spirit as required in the 21st century; and
- To strengthen the professional capacity of and collaboration among teachers in schools and the partnerships with community stakeholders.

Proposed Strategies for Promoting STEM Education

10. In promoting STEM education, the CDC has proposed to adopt a holistic approach through different strategies focusing on strengthening students' ability to integrate and apply knowledge and skills of different disciplines in school education so as to unleash their potential in innovation. It should be noted that the promotion of STEM education in schools should ensure continuous development in the Science, Technology and Mathematics Education KLAs and that forms part of the ongoing renewal of the school curriculum. Six strategies are recommended as below.

Strategy 1 – Renew the Curricula of Science, Technology and Mathematics Education KLAs

11. We are renewing the curricula of Science, Technology and Mathematics Education KLAs and the primary General Studies curriculum in accordance with a set of guiding principles set out by CDC in October 2015 and considerations specific to promoting STEM education.

12. The updated curriculum frameworks of the Science, Technology and Mathematics Education KLAs will highlight the importance of strengthening students' integration and application of knowledge and skills across disciplines. The updated curriculum contents will keep students abreast of the latest developments in various fields of science and technology. For example, the Science (Secondary 1-3) curriculum will be updated to include topics related to the recent development in science and technology, especially in the field of life sciences (e.g. DNA as the book of life, Biotechnology and health). For the Technology Education KLA (Secondary 1-3) curriculum, at least 30% of curriculum time under Information and Communication Technology (ICT) is

allocated to the learning and teaching of programming concepts (including coding). The Mathematics curriculum (P1-S6) will be reviewed to enhance alignment with other KLAs and support of Mathematics in the promotion of STEM education. The contents of the primary General Studies (GS) curriculum are updated to put more emphasis on the relevance of science and technology to daily life (e.g. low carbon living, global warming).

13. Suggested learning and teaching activities will also be provided for teachers' reference. We will promote pedagogies that could facilitate students to integrate and apply knowledge and skills (e.g. through scientific investigation, project learning, problem-based learning, design-and-make activities).

Strategy 2 – Enrich Learning Activities for Students

14. EDB is taking actions to enrich learning activities for students to promote the culture of cross-disciplinary learning of Science, Technology and Mathematics. We will organise an education fair for students to showcase and celebrate a wide range of student achievements on STEM related areas on a regular basis. This signature event will also provide quality learning experiences for students to enhance their interests, creativity and innovation and to strengthen their ability in integrating and applying both knowledge and skills in solving authentic problems. Development in different STEM areas of Hong Kong and further study opportunities will also be showcased in the event.

15. We will continue to advise schools to effectively use “school-based flexible time” of central time allocation and outside classroom learning for engaging students in worthwhile learning experiences (e.g. cross-curricular and cross-KLA project learning or competitions). We will also broaden students' learning by providing opportunities for them to participate in local, national and international competitions related to STEM to enrich the learning experiences of students with different interests and abilities, and to unleash their potential in STEM areas. Besides, students with special talent in STEM areas will be nominated to apply for local and overseas scholarships so as to widen their horizons and encourage them to engage in further study related to STEM professions. (Annex 2 on the plan for organising student activities/competitions refers.)

Strategy 3 – Provide Learning and Teaching Resources

16. Schools are recommended to make good use of existing resources for supporting the implementation of the curricula of the Science, Technology and Mathematics Education KLAs, such as equipment in the special rooms, IT

facilities, audio-visual aids, books in the school library, learning and teaching resources packages, to promote STEM education.

17. We will provide further resource materials for teachers' reference, including annotated school cases, cross-disciplinary activities, project learning, life-wide learning activities, and information on STEM related competitions. These resources serve as reference for schools to organise relevant learning activities within and outside the classroom. Various e-resources related to STEM disciplines, e.g. e-library, online courses, e-textbooks, and other resources related to STEM education accessible from the Internet, will be recommended to enhance the effectiveness of learning and teaching. (Annex 3 on the plan for development of learning and teaching resources refers.)

18. EDB will promote the use of learning and teaching resources related to STEM education via the "EDB One-stop Portal for Learning and Teaching Resources" (OSP) hosted at the Hong Kong Education City Limited (HKECL), and enrich the resources. Besides, the connection and collaboration between EDB and various organisations, such as Hong Kong Science Park and Hong Kong Science Museum, will be strengthened for effective promotion of the relevant learning and teaching resources and life-wide learning activities.

Strategy 4 – Enhance Professional Development of Schools and Teachers

19. To enhance the professional capacity of school heads, curriculum leaders and teachers in promoting STEM education holistically and effectively at school level, EDB is taking steps in strengthening the relevant professional development programmes (PDPs). We will organise symposia for curriculum leaders on a regular basis. Such signature events serve to promote STEM education with participation of relevant stakeholders. Besides, we will continue to organise PDPs for middle managers and teachers in the coming three school years to introduce the appropriate strategies for enhancing students' ability of cross-disciplinary integration and application of knowledge and skills. Seminars and workshops on enriching teachers with the most up-to-date knowledge on STEM related fields will continue to be organised.

20. Learning communities will be set up to enhance professional knowledge exchange within and across schools through different platforms (e.g. Professional Development Schools Scheme (PDS) of Education Development Fund (EDF) and Quality Education Fund (QEF) Thematic Network). We will enhance teachers' exposure to cutting edge development in science and technology fields through exchange with academics/partners in the territory and from the Mainland and overseas. (Annex 4 on the plan for organising professional development programmes refers.)

Strategy 5 – Strengthen Partnerships with Community Key Players

21. All along, EDB has been engaging different stakeholders in the promotion of student learning in STEM areas. There is also a need to further strengthen the partnerships with the stakeholders and maintain professional communities. We will further enhance the communication with local curriculum advisory committees, as well as the school representatives, for enhancing student learning in the KLAs of Science, Technology and Mathematics Education.

22. EDB will strengthen the liaison with academics and practitioners who specialise in various science, technology, engineering and mathematics fields, and explore the feasibility of collaborating with tertiary institutions and specialists in co-organising teacher training programmes and student learning activities. We will also continue to strengthen the partnerships with professional bodies, and other government and non-government organisations (e.g. Hong Kong Science Park, British Council, Hong Kong Federation of Youth Groups, Hong Kong Association for Science and Mathematics Education) in fostering synergy within the community for the promotion of STEM education among schools. (Annex 5 for the list of major community partners refers.)

Strategy 6 – Conduct Review and Disseminate Good Practices

23. Good practices on the promotion of STEM education will be consolidated from schools to showcase and share experiences in organising learning activities to strengthen students' ability to integrate and apply knowledge and skills. We will also conduct research and evaluation studies on the implementation of STEM education at school level and review the curricula as appropriate.

24. EDB will continue to identify exemplary schools that are outstanding in promoting STEM education and consolidate experiences from them in organising cross-disciplinary learning and teaching activities. Besides, we will disseminate good practices through PDPs and Centre of Excellence (CoE), e.g. Professional Development Schools Scheme (PDS) of Education Development Fund (EDF), to support schools on the promotion of STEM education.

Initial Feedback from Consultation

25. Further to the two events of the “Symposia cum Consultation Briefings

on Science, Technology and Mathematics: Promotion of STEM Education – Unleashing Potential in Innovation” organised on 5 & 6 November this year, we have received the following initial feedback on the promotion of STEM education.

- Over 90% of the participants agreed with the overall aim and objectives of promoting STEM education, the recommended approaches for organising STEM related learning activities and the proposed strategies for the promotion of STEM education. There were also views that STEM education should start from primary level. Besides, there were suggestions on the provision of funding to schools by the government for promoting STEM education.

Other concerns include:

- About the renewal of the curricula in relevant KLAs;
- Cross-KLA collaboration among teachers;
- Teachers’ workload and the professional development of teachers/principals;
- Resource allocation, including curriculum time and resource support;
- Issues related to student assessment;
- Expertise of teachers at primary school level; and
- STEM career prospects for students.

26. Within the 2-month consultation period, further views and suggestions from various stakeholders will be collected and organised. We plan to start implementing progressively the proposed strategies mentioned above in the 2016/17 school year at the earliest.

Advice Sought

27. Members are invited to note and offer views on the recommendations and relevant implementation strategies for the promotion of STEM education among schools as set out in this paper.

**Education Bureau
December 2015**

Guiding Principles on Promotion of STEM Education

i. Learner-centred approaches

To facilitate students to learn how to learn through STEM-related learning activities, diversified learning, teaching and assessment strategies should be used to suit the needs and interests of students.

ii. Provision of learning experiences

All students have the ability to learn, and they should be provided with STEM-related learning opportunities which form part of the essential learning experiences, that include learning opportunities beyond classroom.

iii. Striking a balance among different purposes, views and interests

In promoting STEM education, a balance has to be struck with considerations of students' interests and needs, teachers' views and partnerships with community key stakeholders.

iv. Building on strengths

The promotion of STEM education in Hong Kong is building on school experiences and other conducive factors, such as the flexible use of learning time and life-wide learning experiences.

v. Continuous development process

Promoting STEM education at school level is a continuous and dynamic refinement process. This could start with small-scale curriculum development projects to ensure capability in handling unforeseeable problems and offer room for further advancement.

**Promotion of STEM Education
Plan for Organising Student Activities/Competitions**

Student Activities/Competitions

- (i) Large-scale learning activities, in the form of student education fairs, will be organised on a regular basis. The forthcoming event is as follows:-

Event: **Student Education Fair on Science, Technology and Mathematics
2016: Promotion of STEM Education – Unleashing Potential in
Innovation**

Date: 22 & 23 January 2016 (Friday & Saturday)

Time: 10 a.m. – 5 p.m.

Venue: Grand Hall Convention Centre 3, Hong Kong Science Park

- (ii) Major Activities/Competitions:

Local

- Hong Kong Budding Scientists Award (香港科學青苗獎)
- Innovations in Science and Environmental Studies Exhibition (「常識百搭」科學專題探究展覽)
- Hong Kong Robotic Olympiad (香港機械奧運會)
- Mathematics Project Competition for Secondary Schools (中學數學專題習作比賽); Mathematics Book Report Competition for Secondary Schools (中學數學閱讀報告比賽)
- Hong Kong Physics Olympiad (香港物理奧林匹克)
- Statistical Project Competition for Secondary School Students (中學生統計習作比賽); Statistics Creative-writing Competition for Secondary School Students (中學生統計創意寫作比賽)
- Hong Kong Student Science Project Competition (香港學生科學比賽)
- Hong Kong Youth Science and Technology Innovation Competition (香港青少年科技創新大賽)

Mainland

- 高校科學營
- Chinese Mathematical Olympiad (中國數學奧林匹克)
- China Adolescents Science and Technology Innovation Contest (全國青少年科技創新大賽)

International

- International Junior Science Olympiad - Hong Kong Screening (國際初中科學奧林匹克—香港選拔賽); International Mathematics Olympiad Preliminary Selection Contest (國際數學奧林匹克香港選拔賽);

- International Olympiad in Informatics (國際電腦奧林匹克競賽)
- Intel International Science and Engineering Fair (Intel ISEF) (英特爾國際科學與工程大獎賽)

**Promotion of STEM Education
Plan for Development of Learning and Teaching Resources**

Resource materials in 5 categories to be developed from 2015/16 to 2017/18 school years:

Categories	Number of items		
	Secondary	Primary	Total
	SE / TE / ME	GS / ME	
i. Learning and teaching activities	6	2	8
ii. Cross-curricular / cross-KLA projects	6	2	8
iii. Annotated school practices	6	2	8
iv. LWL activities and competitions	6	2	8
v. Reference materials	6	2	8
Total:	30	10	40

EDB One-Stop Portal for Learning and Teaching Resources (OSP):
<http://www.hkedcity.net/edbosp/>

**Promotion of STEM Education
Plan for Professional Development Programmes**

Professional Development Programmes from 2014/15 to 2017/18:

Programme	School year			
	2014/2015	2015/2016	2016/2017	2017/2018
	Half-day Course			
	No. of participants	No. of participants	No. of participants	No. of participants
<u>Principals and Middle Managers</u> (KLA Coordinator / Panel Head/ PSM(CD)) (1) Symposium	400	800	800	800
<u>Middle Managers & teachers</u> (2) Understanding & Interpreting the Curriculum	-	1500	1500	1500
(3) Curriculum Planning	-			
(4) Learning, Teaching and Assessment	-	1500	1500	1500
(5) Enriching Knowledge	-			
(6) Networking Activities (by district)	-	1600	1600	1600

Major Community Partners on Promotion of STEM Education

- Agriculture, Fisheries and Conservation Department
- Arts and Technology Education Centre
- British Council
- Caritas Chan Chun Ha Field Studies Centre
- Census and Statistics Department
- Hong Kong Academy for Gifted Education
- Hong Kong Association for Science and Mathematics Education
- Hong Kong Association of Careers Masters and Guidance Masters
- Hong Kong Education City Limited
- Hong Kong Federation of Youth Groups
- Hong Kong New Generation Cultural Association
- Hong Kong Observatory
- Hong Kong Productivity Council
- Hong Kong Science Museum
- Hong Kong Science and Technology Parks Corporation
- Hong Kong Space Museum
- Hong Kong Statistical Society
- Hong Kong Technology Education Association
- Ho Koon Nature Education cum Astronomical Centre (Sponsored by Sik Sik Yuen)
- Ocean Park Academy, Hong Kong
- Sik Sik Yuen Biotechnology Mobile Laboratory
- Vocational Training Council
- All tertiary institutes of Hong Kong