# Report on
# Promotion of STEM Education
## *Unleashing Potential in Innovation*

教育局
Education Bureau

December 2016

# Contents

# Preamble

To better prepare our students for the rapid economic, scientific and technological developments ahead, STEM education is being promoted as a key emphasis in the ongoing renewal of the school curriculum that is essential for their lifelong learning and whole-person development.

The promotion of STEM education was first proposed in the 2015 Policy Address and further supported in the 2016 Policy Address. Apart from cultivating students' interest in Science, Technology and Mathematics, and developing among them a solid knowledge base, we aim to strengthen students' ability to integrate and apply knowledge and skills across different STEM disciplines, and to nurture their **creativity, collaboration and problem solving skills**, as well as to foster their **innovation and entrepreneurial spirit** as required in the 21st century. Through the promotion of STEM education in schools, we aim to nurture a versatile pool of talents with different sets and levels of skills to enhance the competitiveness of Hong Kong.

We have been promoting STEM education among schools in a holistic and coherent manner, with strategies that embrace **renewing the curricula of the Science, Technology and Mathematics Education KLAs**, **enriching the learning activities for students**, **providing learning and teaching resources**, **enhancing professional development of schools and teachers**, **strengthening partnerships with community stakeholders and maintaining professional communities**, as well as **conducting reviews and disseminating good practices**.

A consultation document, namely "Promotion of STEM Education – Unleashing Potential in Innovation" was released in November 2015 to introduce the proposed strategies above. Two symposia cum consultation sessions have been organised to solicit initial views from school principals and teachers. Separate consultation sessions have also been held for different STEM-related KLAs and the related curricula. In addition, focus group meetings have been arranged for relevant stakeholders. The

general feedback collected from consultation sessions, meetings and other channels about the initiative to promote STEM education in schools is positive and encouraging.

We must express our heartfelt gratitude to all the stakeholders for contributing valuable comments and suggestions during the consultation period. They have expressed unanimous support for the aims and objectives, recommendations and strategies for promoting STEM education in Hong Kong. Local primary and secondary schools generally found the proposed measures feasible in schools as these are built upon their past experiences. Furthermore, we are pleased to learn that with STEM education being highlighted as a curriculum emphasis, some schools have become more proactive in implementing STEM education at the school level. We shall continue to identify good practices from schools and facilitate sharing of successful experiences through networking activities. Furthermore, many local tertiary institutions, non-government organisations (NGOs), professional bodies and other stakeholders have expressed enthusiasm to arrange relevant learning activities for students and to provide training programmes for teachers.

We are confident that with consensus among different stakeholders and concerted efforts of schools and relevant partners, the recommended actions in this Report would lead us to a new phase of quality education that can unleash the potential of all students and equip them with necessary knowledge, skills and attitudes to live and develop in the contemporary world of evolving science and technology.

# Chapter 1    Introduction

## Community Participation in Formulating the Strategies for Promoting STEM Education in Schools

### *Background*

1.1    STEM is an acronym that refers collectively to the academic disciplines of Science, Technology, Engineering and Mathematics.   In response to the changing needs in our society and the rapid economic, scientific and technological developments in the 21st century, it is essential to promote STEM education and hence equip our students with the capability to meet the changes and challenges in society and around the world.

1.2    In the curriculum context of Hong Kong, STEM education is promoted through Science, Technology and Mathematics Education.   As proposed in the 2015 Policy Address, the Education Bureau (EDB) would renew and enrich the curricula and learning activities of the Science, Technology and Mathematics Key Learning Areas (KLAs), and enhance the training of teachers, thereby allowing primary and secondary students to fully unleash their potential in innovation.   In promoting STEM education, reference has been made to the strategies and measures of other countries/regions for their promotion of STEM education.   EDB launched a consultation from early November 2015 to early January 2016 on promoting STEM education to collect views and suggestions on the aims, objectives and proposed strategies related to the promotion of STEM education in local primary and secondary schools.

1.3    The promotion of STEM education in schools of Hong Kong aims at further developing students to become lifelong learners of science and technology.   Our aim is to enable students to meet the challenges of the 21st century.   From a wider perspective, we hope to nurture versatile talents with different sets and levels of knowledge and skills so as to enhance the international competitiveness of Hong Kong, and in turn contribute to national developments.   Major objectives to achieve include developing a solid knowledge base among students and enhancing their interests in Science, Technology and Mathematics,

strengthening students' ability to integrate and apply knowledge and skills, nurturing creativity, collaboration and problem solving skills of students, and also strengthening the partnerships with community stakeholders, and developing talents/experts in STEM-related areas to foster the development of Hong Kong.

1.4    To promote STEM education, we have proposed to adopt a holistic approach through six strategies as follows:

   (1)    Renewing the curricula of the Science, Technology and Mathematics Education KLAs;

   (2)    Enriching learning activities for students;

   (3)    Providing learning and teaching resources;

   (4)    Enhancing the professional development of schools and teachers;

   (5)    Strengthening partnerships with community key stakeholders; and

   (6)    Conducting review and disseminating good practices.

### Stakeholders Consultation

1.5    A consultation document entitled *Promotion of STEM Education – Unleashing Potential in Innovation* was released on 5 November 2015. The document and other relevant materials are accessible at the EDB website.   A two-month consultation followed to collect feedback from various stakeholders in the education and other sectors of the community.

### Summary of Recommendations after Consultation

1.6    Positive response was received from different stakeholders during the consultation period and in recent focus group meetings after the consultation.   After deliberation of feedback from schools and other key players on the six proposed strategies, a summary of recommendations that pave the way forward for promotion of STEM education is highlighted below for information. EDB will follow up with appropriate actions, in collaboration with stakeholders, in the following as elaborated in the ensuing chapters of this report.

I. Updating the curricula of the Science, Technology and Mathematics Education KLAs, including KLA Curriculum Guides and relevant subject guides, to align with the ongoing renewal of school curriculum with the focus on nurturing students' creativity, collaboration, problem solving skills and innovativeness through student-centred pedagogies, and pave the way for nurturing students' entrepreneurial spirit in senior secondary subjects such as Applied Learning courses.

II. Strengthening the provision of quality learning experiences to students through support to schools on whole-school curriculum planning and collaboration with relevant organisations.

III. Offering KLA-based and cross-KLA resource materials to schools to enhance learning and teaching on STEM-related areas and providing additional resources support for catering to their school-based needs.

IV. Strengthening the professional capacity, knowledge transfer and cross-fertilisation among schools and teachers for building communities of practice on STEM education.

V. Synchronising the contributions from different community key players to enhance the promotion of STEM education in the territory.

VI. Adopting actions to review the development of STEM education, consolidate the good practices for dissemination and generate knowledge for transfer.

### *Consultation process and feedback*

1.7 A multiple-channel approach with interactive engagement was adopted in the consultation exercise to solicit views on the aims, objectives and also the six strategies proposed for the promotion of STEM education, with the education sector being the major stakeholder group. The policy initiative has been deliberated carefully in various curriculum advisory committees and focus group meetings comprising representatives from the school sector, professional bodies and tertiary

institutions.    At the same time, views and suggestions were also gathered from other STEM-related organisations, parents and the general public.

1.8    Questionnaires were administered to all primary and secondary schools to collect views on the promotion strategies, as well as to participants in symposia from November 2015 to January 2016. Other stakeholders and the public have also offered useful feedback through various consultation events and the mass media, and also by written submissions.    A summary of the major feedback from different stakeholders is at Appendix 1.

1.9    The feedback from schools has revealed that there is a general consensus on the need to strengthen students' ability to integrate and apply their knowledge and skills across different subject disciplines. The majority of respondents (>90%) agreed or strongly agreed with the promotion of STEM education as a key emphasis of the ongoing renewal of the school curriculum.    Over 80% of respondents agreed or strongly agreed with the two approaches proposed for organising learning activities on STEM education, and over 80% supported the proposed strategies for promoting STEM education.    A summary of the survey findings is at Appendix 2.

1.10    On the whole, stakeholders of different sectors have shown support for the implementation approaches and proposed strategies for the promotion of STEM education.    Though we have also received minor concerns from individuals, these serve as useful hints and suggestions that facilitate our action of fine-tuning the measures/actions for the promotion of STEM education.

### Purpose of the Report

1.11    This report aims to chart the way forward based on the feedback collected during the consultation.    The following chapters present the proposal in the consultation document, views and feedback collected and the final recommendations for each proposed strategy.

*Organisation of the Report*

1.12 This chapter sets out the background of the consultation on promoting STEM education and the multiple channels to collect stakeholders' views on the aims, objectives, proposed approaches and implementation strategies. Recommendations and relevant actions that EDB will follow up after the consultation are also highlighted. The policy context, purpose and the guiding principles for promoting STEM education are presented in Chapter 2.

1.13 Chapters 3 to 8 present the final recommendations with support measures/actions, where appropriate, in response to the supportive views, concerns and suggestions of stakeholders.

**Chapter 2**

**The Policy Context, Purpose and Guiding Principles –
Promoting STEM Education, Unleashing Potential in Innovation**

*The Policy Contexts*

2.1    The following paragraphs outline the contexts in relation to the promotion of STEM education in Hong Kong, including the macro environment, our strengths and experiences, areas for further development, as well as the final recommendations that guide our way forward for promoting STEM education.

The macro environment

2.2    The initiative to promote STEM education in schools is proposed in the light of the following macro environment:

(a)    There is a worldwide education trend in equipping students with the capability to meet the changes and challenges in the contemporary world, against the backdrop of rapid economic, scientific and technological developments in the 21st century.

(b)    There is a need for Hong Kong to maintain its international competitiveness and fulfill the needs of economic, societal, scientific and technological developments and in particular to foster innovation and an entrepreneurial spirit.    It is of paramount importance to nurture a range of talents with different capabilities and at different knowledge and skills through STEM education, especially when opportunities arise for Hong Kong to contribute to major initiatives for national developments.

(c)    The Government has been actively promoting Innovation and Technology.    The public awareness of the importance of innovation in STEM-related fields is also increasing.    This context is conducive to the promotion of STEM education among schools.

(d)    The 2015 and 2016 Policy Addresses have shown support for the

promotion of STEM education. Emphases are put on the curriculum renewal of the Science, Technology and Mathematics KLAs, enriching learning activities, and enhancing the training of teachers for strengthening STEM education.

2.3 For the promotion of STEM education among primary and secondary schools in the territory, we are aware of our strengths and experiences, as well as the existing limitations/areas for further development:

<u>Strengths and experiences</u>

(a) The elements of STEM education are embedded in the three KLAs of Science, Technology and Mathematics Education of the local school curriculum. Schools have already had different experiences in organising STEM-related learning activities.

(b) 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).

(c) A wide range of STEM-related competitions/activities at territory-wide, national and international levels are available for students' participation. Generally speaking, students actively participate in the events.

(d) Many schools are keen on arranging students to participate in various STEM-related activities within and outside the school.

(e) Various professional bodies, tertiary institutions, government/non-government organisations in the community are enthusiastic in providing support for the promotion of STEM-related learning activities for students.

<u>Existing limitations/Areas for further development</u>

(f) Students were found to focus on acquiring knowledge of individual subjects and may not evenly participate in hands-on

activities in schools.  Therefore, it is necessary to strengthen their ability to integrate and apply their knowledge and skills across different subject disciplines through solving daily life problems with practical solutions and innovative designs.

(g)     To further enhance the effectiveness of learning and teaching, the coherence and collaboration among teachers of the relevant KLAs in planning and organising STEM-related learning activities needs to be strengthened.

(h)     There is a need to further strengthen the provision of professional development programmes, curriculum resources, etc. for primary and secondary schools.  We also have to encourage sharing among schools to enhance the professional capacity of teachers.

(i)     There is also a need for strengthening the partnerships among different community stakeholders in fostering synergy for the promotion of STEM education in primary and secondary schools. These may include university admission policies that are encouraging more STEM-related subjects, opportunities in the job market, and changing parental values on the importance and contribution of STEM education to the well-being of mankind.

### *Proposals*

2.4     The objectives of promoting STEM education are to develop among students a solid knowledge foundation and enhance their interests in Science, Technology and Mathematics, to strengthen their ability to integrate and apply knowledge and skills to solve authentic problems, as well as to foster innovation and entrepreneurial spirit as required in the 21st century, so that students are better equipped for further studies and careers in meeting the changes and challenges in the contemporary world.

2.5     When planning, designing and implementing STEM-related learning activities, teachers are encouraged to closely collaborate with their counterparts of the relevant KLAs, so as to facilitate students' integration and application of knowledge and skills across disciplines.

2.6     Two different approaches as listed below are proposed for organising STEM-related learning activities. A diagrammatic illustration of these two approaches is shown in Appendix 3.   Depending on the school context, students' interests and abilities, as well as the teachers' expertise, schools may adopt approaches other than these, whichever appropriate.

### *Approach One*

• Learning activities based on topics of a KLA for students to integrate relevant learning elements from other KLAs.

### *Approach Two*

• Projects for students to integrate relevant learning elements from different KLAs.

### *Expected Outcomes*

2.7     Effective promotion of STEM education with the concerted efforts of various stakeholders could benefit students, teachers, school leaders, other relevant stakeholders, and even Hong Kong as a whole.   The expected outcomes of promotion of STEM education are:

(a)     **Students'** ability to integrate and apply knowledge and skills across disciplines to solve authentic problems is strengthened through STEM-related learning activities.   Their creativity, collaboration and problem solving skills are enhanced while potential in innovation is unleashed.   While the objectives of STEM education and ideas related to integration and application of knowledge and skills as advocated are included in the KLAs of Science, Technology and Mathematics Education, students are expected to enhance their learning effectiveness within and across KLAs.   These could facilitate lifelong learning and whole-person development of students.   Besides, students' exposure would be broadened by engaging in different related learning opportunities, including local, national, and/or

international competitions/events related to STEM education. The learning experiences could facilitate students to choose STEM-related electives and Applied Learning leading to the Hong Kong Diploma of Secondary Education (HKDSE), and prepare for their future studies and careers in STEM-related areas and other fields requiring relevant knowledge, skills and attitudes.

(b)  **Teachers'** expertise in organising and implementing STEM-related learning activities is enhanced through sharing with their counterparts of relevant KLAs and exchange with academics/specialists of STEM-related fields. The professional capacity of teachers and the collaboration among them within and across schools would be strengthened.

(c)  **School leaders** in STEM education could be nurtured for planning the implementation of STEM education holistically and effectively at school level according to their school context to suit the needs and interests of students. As part of the whole-school curriculum planning on STEM education, schools could assign a teacher to serve as a coordinator to oversee the planning, implementation and evaluation of the promotion of STEM education at school-based level. In addition, schools could enhance their capacity through engagement of various stakeholders and the community at large to enhance student learning.

(d)  **Other stakeholders** are actively engaged in the promotion of student learning in STEM-related areas. The communication and partnership with local and non-local professional bodies, tertiary institutions, government and non-government organisations would be enhanced in order to foster synergy within the community for facilitating student learning.

(e)  **Hong Kong as a whole** can gain benefits from the nurturing of a range of talents with different capabilities and at different knowledge and skill levels that fulfill the needs of economic, scientific and technological developments in the contemporary world, hence helping maintain the international competitiveness

of Hong Kong and foster innovation and entrepreneurial spirit.

*Final Recommendations*

2.8    We have carefully considered the views collected from different channels during the consultation period.   In charting the way forward, we would adhere to the following guiding principles for promoting STEM education and adopt a holistic approach at the system and the school levels for the implementation.

   (a)    **Adopting a learner-centred approach** with focus on facilitating learners to acquire the skills on how to learn through STEM-related activities, diversified learning, teaching and assessment strategies that suit the needs and interests of students.

   (b)    **Enhancing** STEM-related learning opportunities to form part of the **essential learning experiences**, inclusive of learning opportunities beyond the classroom.

   (c)    **Striking a balance** between students' interests and needs, teachers' views and partnerships with other stakeholders.

   (d)    **Building on strengths** of schools' past experiences and other conducive factors for the promotion of STEM education.

   (e)    **Promoting** STEM education as a **continuous and dynamic improvement process**, preferably starting from small-scale curriculum development projects which allow tolerance of ambiguity and room for further advancement.

2.9    Promotion of STEM education is highlighted as one of the major curriculum focuses of the KLAs of Science, Technology and Mathematics Education in the ongoing renewal of the school curriculum for lifelong learning and whole-person development of students.

2.10   It should be noted that the promotion of STEM education in schools should ensure continuous development in the Science, Technology and

Mathematics Education KLAs.  A progressive approach with concerted efforts is required for sustainable development of promoting STEM education in schools.  The aims and objectives of promoting STEM education will be achieved through appropriate strategies and concerted efforts among EDB, schools and community stakeholders.

# Chapter 3

## Strategy 1　Renewing the Curricula of the Science, Technology and Mathematics Education KLAs

We have proposed in the consultation document the renewal of the curricula of the Science, Technology and Mathematics Education KLAs and also the primary General Studies curriculum in accordance with a set of guiding principles set out by the Curriculum Development Council (CDC) and the considerations specific to promoting STEM education (guiding principles in paragraph 2.8 refer).

### *Proposals*

#### Updating the curriculum frameworks and contents

3.1　To update the curriculum frameworks of the KLAs of Science, Technology and Mathematics Education highlighting the importance of strengthening students' integration and application of knowledge and skills across disciplines, and to update the curriculum contents to keep students abreast of the latest developments in various fields of science and technology.

#### Promotion of student-centred pedagogies

3.2　To promote pedagogies that could facilitate students to integrate and apply knowledge and skills, including the use of scientific investigation, project learning, problem-based learning, design and make activities and mathematical modeling.

### *Supportive Views*

#### Updating the curriculum frameworks and contents

3.3　Schools generally agreed with the direction and focus of updating the Science (S1-3) curriculum, the Technology Education KLA (S1-3) curriculum and the primary General Studies curriculum.　They have also shown support for the review of the Mathematics curriculum (P1-S6).　(Disciplinary knowledge and skills of each KLA remain the

basics for the interdisciplinary/cross-curricular activities to build on.)

3.4 They expressed the view that the implementation of STEM education should start from the primary level as this would help cultivate students' interest in STEM-related areas in their earlier years of studies.

<u>Promotion of student-centred pedagogies</u>

3.5 Schools generally agreed with the adoption of pedagogies that could facilitate students to integrate and apply knowledge and skills across disciplines.

3.6 They shared the view that the provision of hands-on learning activities for students to solve authentic problems is essential.

3.7 Teachers generally agreed that students' interests and curiosity can be cultivated through hands-on and minds-on STEM-related activities. They also showed support for the enrichment of learning and teaching activities allowing students to integrate and apply knowledge and skills of different KLAs, and hence to foster their innovation and problem solving skills. (Disciplinary knowledge and skills of each KLA remain the basics for these activities to build on.)

***Major Concerns and Suggestions***

<u>Updating the curriculum frameworks and contents</u>

3.8 Teachers were concerned that they might not have sufficient lesson time to implement STEM-related learning activities.

3.9 In relation to maximising the effectiveness of implementing STEM education, some stakeholders have suggested the need to strengthen the interface between the primary and secondary levels.

3.10 Some teachers showed concern over the alignment of teaching sequences between the curricula of Mathematics and Science for strengthening the effectiveness of student learning.

3.11 Some stakeholders have suggested that subjects related to information technology need to be updated.

3.12 There were suggestions from academics and school principals that, in view of the ever-expanding knowledge in STEM-related areas, it might not be feasible to include too many topics in the relevant curricula. Instead, it is more suitable to build a solid disciplinary knowledge base among students with appropriate focus on and connection to STEM-related areas.

Promotion of student-centred pedagogies

3.13 Individual stakeholders have suggested that the notion of "engineering design" is important in STEM-related learning.

3.14 There were views that schools should focus on developing students' innovativeness and problem solving skills through KLA-based and cross-KLA activities. For acquiring knowledge and skills specific to engineering, schools might consider incorporating those engineering-related programmes offered by professional bodies or tertiary institutions as extended learning activities for students.

3.15 In relation to implementing STEM education, the issues of catering for learner diversity and student assessment, including public assessment, are raised.

*Final Recommendations*

**EDB would update the curricula of the KLAs concerned to align with the ongoing renewal of the school curriculum with the focus on nurturing students' creativity, collaboration, problem solving skills and innovativeness through student-centred pedagogies, and pave the way for nurturing students' entrepreneurial spirit in senior secondary subjects such as Applied Learning courses.**

Updating the curriculum frameworks and contents

3.16 The updated KLA Curriculum Guides of Science, Technology and Mathematics Education will be available in the 2016/17 school year.

With updated curriculum aims and frameworks, the Curriculum Guides would serve as useful references for schools on the design of school-based curriculum, learning and teaching, as well as assessment for the three KLAs, with recommendations also given on the flexible use of curriculum time, more cross-KLA collaboration and strategies to embrace learner diversity.

3.17 On updating the relevant curricula of the KLAs, due consideration has been given to strengthening the vertical continuity and lateral coherence. The Science (S1-3) curriculum has been updated to enable students to keep abreast of the rapid development in science and technology, especially in the field of life sciences. It is worth noting that the depth of treatment of the topics is commensurate with the cognitive development of students at the junior secondary level. Relevant briefing seminars on the updated curriculum have been made by the end of 2015/16 school year. The curriculum is available for those schools which are more ready to pilot/adopt the strategies in learning and teaching from the 2016/17 to 2017/18 school years. It is also planned that the curriculum is recommended for territory-wide implementation in schools in the 2018/19 school year.

3.18 In respect of the enriched Technology Education (S1-3) curriculum, it includes under the Information and Communication Technology (ICT) knowledge context 30% curriculum time on programming. Further to the curriculum implementation by phases from the 2014/15 school year for S1 and 2015/16 school year for S1 & S2, full implementation of the curriculum from S1 to S3 is in place in the 2016/17 school year.

3.19 The senior secondary ICT curriculum has been updated with enhancement of the "algorithm testing" part in Basic Programming Concepts of the compulsory part. The updated curriculum starts to be implemented in S4 from the 2016/17 school year.

3.20 Regarding the updating of the Mathematics curriculum (P1-S6), a review is now in progress. The major results of the review of primary and junior secondary curricula would be announced in 2016/17, whereas the senior secondary curriculum framework will be announced in 2017.

3.21 For the primary General Studies curriculum, the curriculum is under review and will be ready for consultation by the end of 2016. The updated curriculum puts more emphasis on the relevance of science and technology to daily life. It is expected that the revised curriculum will be available in the 2017/18 school year. For those schools which show more readiness, they could pilot the learning and teaching in the same year. It is also planned that the curriculum is recommended for territory-wide implementation in schools in the 2018/19 school year.

3.22 In planning the time allocation for the above curricula, schools should refer to the most updated version of the curriculum documents of respective KLAs/subjects as well as the Primary Education Curriculum Guide and the Secondary Education Curriculum Guide due to be released on the EDB website for the recommended curriculum time. To align with the recommendations, schools need to allocate adequate but not excessive lessons to each KLA/subject concerned taking into consideration the overall learning needs of their students and their unique contexts. Schools are also encouraged to use the designated "flexible time" effectively to conduct cross-curricular learning activities, including STEM-related ones and to ensure the whole-school curriculum is broad and balanced in terms of promoting whole-person development.

Promotion of student-centred pedagogies

3.23 We will promote pedagogies that could facilitate the integration and application of knowledge and skills in problem solving to create solutions and make inventions with hands-on and minds-on activities for the above-mentioned updated curricula. During the process, opportunities will be arranged for students to collaborate with peers. Elements of "design and make" which cover the notion of "engineering design" have been incorporated in the learning activities. Relevant examples on learning and teaching will be provided for teachers' reference.

3.24 At the primary level, coding is recommended to be introduced to develop students' computational thinking. Teachers of information technology and other subjects, including General Studies, are encouraged to collaborate and provide opportunities for students to

acquire and apply skills of coding through appropriately designed learning activities.

3.25 The learning and application of three-dimensional (3D) printing technology provides a typical example of STEM education. We encourage schools to make good use of 3D printing technology to enhance student learning in the Science, Technology and Mathematics Education KLAs.

3.26 Being closely related to the qualities embedded in an entrepreneurial spirit such as possessing creativity and innovativeness, taking initiative and responsibilities, taking calculated risks and upholding perseverance, STEM education provides ample opportunities to nurture these qualities in students through the updated curricula in various KLAs and promotion of student-centred pedagogies. This helps pave ways to enhance students' entrepreneurial spirit in senior secondary subjects. For example, Applied Learning offers many courses, like those under the areas of studies of Applied Science and Engineering and Production, which provide contexts for promoting entrepreneurial spirit in students through STEM-related topics and learning activities. During the process, students conceive innovative ideas, turn ideas into actions, learn to stay positive in times of uncertainty and make the best of the opportunities ahead. They may also see new business opportunities for their future endeavours.

3.27 Regarding the promotion of student-centred pedagogies for STEM education in schools, EDB would make continued reference to international practices, as well as the latest worldwide trend in learning, teaching and assessment. While EDB would introduce and update teachers about various pedagogies that can promote student-centred learning, teachers have to decide which pedagogies can best suit their students and their school-based needs.

3.28 Regarding the assessment for STEM-related learning activities, it should align with the learning objectives as well as the pedagogies adopted to reflect the learning progress and the capability of students as independent/collaborative learners.

**Chapter 4**

**Strategy 2    Enriching Learning Activities for Students**

This chapter is about the arrangements to enrich student learning activities for promoting the culture of cross-disciplinary learning of Science, Technology and Mathematics.

*Proposals*

Key events for students

4.1    To organise an education fair for students to showcase and celebrate a wide range of student achievements on STEM-related areas on a regular basis.

Planning for other STEM-related learning opportunities

4.2    To advise schools to effectively make use of 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).

4.3    To broaden student learning by providing opportunities for them to participate in local, national, and/or international competitions related to STEM education.

4.4    To nominate students with special talent in STEM areas to apply for local and overseas scholarships so as to widen their horizons for facilitating their specialisation in future studies on STEM-related disciplines.

*Supportive Views*

4.5    The respondents have showed strong support for enriching the learning activities for students.

4.6    Some teachers supported the view that the implementation of STEM-related learning activities should be carried out in a progressive

approach. Such an approach allows schools to consolidate experiences through try out practices.

<u>Key events for students</u>

4.7 The Student Education Fair on Science, Technology and Mathematics newly organised in January 2016 was well received. School principals, teachers and other stakeholders, including parents, professional bodies, etc. considered this signature event to have provided a good platform for students to showcase their achievements and it helped cultivate students' interests in STEM related disciplines.

4.8 As elements of life-planning on students' further studies and career development were available, the Education Fair enabled students to have a better understanding of STEM-related fields.

***Major Concerns and Suggestions***

<u>Planning for other STEM-related learning opportunities</u>

4.9 There was a suggestion that both primary and junior secondary students could have more room to engage in STEM-related learning activities, including those conducted inside and outside the classroom.

4.10 There were requests for strengthening the school-based support for planning and organising various STEM-related learning activities.

4.11 The idea of "STEM Maker" was well supported by some teachers. It was considered essential for students to link their learning with solving problems related to daily life. Besides, given the flexible nature of the studies on technology, the learning of technology offered an effective platform for students to integrate and apply knowledge and skills, including hands-on skills, through engaging in STEM learning.

4.12 Some stakeholders considered that a range of learning activities that are cross-curricular in nature were suitable for infusing STEM-related elements. The activities could be implemented through task-based learning, such as project learning in STEM-related KLAs and Independent Enquiry Study (IES) of Liberal Studies.

4.13 There were suggestions on enhancing efforts to encourage students of different capabilities and backgrounds to participate in various STEM-related activities with examples, such as the WorldSkills Hong Kong Competition (school version).

4.14 Some stakeholders showed concerns that students are already fully occupied with other learning activities. It may be difficult for students to squeeze time to engage in STEM-related ones.

4.15 There were suggestions on further promoting those student exchange programmes related to STEM areas with Mainland cities and overseas countries.

*Final Recommendations*

**EDB would adopt the actions as listed below to strengthen the provision of quality learning experiences to students through support to schools on whole-school curriculum planning and collaboration with relevant organisations.**

Key events for students

4.16 Based on the positive feedback on the Student Education Fair on Science, Mathematics and Technology 2016 organised in collaboration with the Hong Kong Science and Technology Parks Corporation, and that on the student events of The InnoTech Expo 2016 organised by Our Hong Kong Foundation with EDB as a supporting organisation, EDB will continue to partner with relevant bodies in organising some large-scale STEM-related events for students. These would 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.

4.17 As part of the programmes of the WorldSkills Hong Kong Competition cum Carnival 2017 to be hosted by the Vocational Training Council (VTC) in June 2017, a collection of activities including STEM-related competitions and demonstrations will be organised by EDB for secondary school students to showcase the skills-related learning outcomes and to develop their early career interests. Quality learning

experiences will be provided to students participating in the competitions and also those visiting the event.

Planning for other STEM-related learning opportunities

4.18 Schools are advised to adopt whole-school curriculum planning, with flexible use of curriculum time, to incorporate elements of STEM education into the school curriculum for broadening students' learning experiences through time-tabled lessons and other life-wide learning activities beyond the classroom, including arranging for students to participate in various local, national, and/or international STEM-related competitions/events/study tours. It should be noted that STEM-related learning opportunities should be provided for students of different capabilities.

4.19 EDB will strengthen the school-based support to schools on holistic curriculum planning, including collaboration among KLAs in organising various STEM-related activities, to cater for the needs of students of different capabilities and backgrounds.

4.20 We will strengthen the collaboration with various STEM bodies, e.g. The Academy of Sciences of Hong Kong, Hong Kong Science and Technology Parks Corporation, in providing STEM-related activities for enriching students' learning experiences. This could facilitate the provision of various STEM learning opportunities for students.

4.21 To ensure provision of quality STEM-related learning opportunities in Applied Learning, EDB will continue to review and strengthen the existing Applied Learning courses of both the areas of studies on "Applied Science" and "Engineering and Production", as well as providing tasters and extension programmes as appropriate.

4.22 Flexibility is provided for schools to implement their school-based STEM-related learning activities. Different schools may organise learning activities on different specific themes in accordance with their student interests, school contexts and teacher expertise, as well as the stage of developing STEM education.

4.23 EDB will continue to stretch the potential of the gifted students. We will cooperate with The Hong Kong Academy for Gifted Education to provide challenging off-site enrichment and extension learning opportunities and explore new ones for exceptionally gifted students.

4.24 In collaboration with other relevant organisations, EDB has launched the Inter-school Cross-curricular Project Competition on Climate Change between October 2016 and mid 2017 on the mitigation, adaptation and/or resilience strategies to cope with climate change. This Competition provided an effective learning platform for nurturing global citizenship and caring attitude towards the well-being of mankind by using knowledge and skills of STEM.

**Chapter 5**

**Strategy 3    Providing Learning and Teaching Resources**

This chapter presents the proposals and relevant work progress in relation to the learning and teaching resources provision to schools for supporting the implementation of the curricula of the Science, Technology and Mathematics Education KLAs.   Schools are also advised to make good use of the resources provided, including the existing ones, to facilitate student learning in STEM-related disciplines.

*Proposals*

5.1    To 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.

5.2    To suggest 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, for effective learning and teaching.

5.3    To promote the use of learning and teaching resources related to STEM education on the "EDB One-stop Portal for Learning and Teaching Resources" (OSP) hosted by the Hong Kong Education City Limited (HKECL), and to enrich the resources.

5.4    To strengthen the connection between EDB and various organisations, such as Hong Kong Science and Technology Parks Corporation, and Hong Kong Science Museum, for effective dissemination of learning and teaching resources and life-wide learning activities.

*Supportive View*

5.5    Most school principals and teachers strongly supported the provision of learning and teaching resources for schools in promoting STEM education.

*Major Concerns and Suggestions*

5.6 Most schools have requested the provision of other resources support (e.g. additional funding for schools).

5.7 Individual respondents have suggested the use of a wide variety of tools and kits, e.g. free tools on the web that could facilitate the promotion of STEM education in schools.

5.8 Individual teachers raised that, apart from the provision of resource packages, hints on some small-scale STEM activities would be useful for learning and teaching.

*Final Recommendations*

**The following actions serve to offer KLA-based and cross-KLA resource materials to schools to enhance learning and teaching on STEM-related areas and to provide additional resources support for catering to their school-based needs.**

One-off grant for schools

5.9 To facilitate the promotion of STEM education in primary schools, EDB has disbursed a one-off grant for the promotion of STEM education to all government, aided and DSS primary schools, including special schools with a primary section, in March 2016. The amount of the grant was HK$100,000 per school.

5.10 The grant aims at enhancing schools' capacity to strengthen the planning and organisation of STEM-related learning activities to foster students' inquisitive mind and promote their interest in the learning of science and technology. Given the flexibility of using the grant, schools may make use of it to purchase equipment/resource materials and organise STEM-related learning activities, etc. to meet their school needs.

5.11 EDB will explore the feasibility of disbursing a one-off grant of a similar nature to secondary schools for the promotion of STEM education.

<u>Resources development for updated curricula</u>

5.12 For the updated Science (S1-3) curriculum, EDB has initiated relevant curriculum development projects with the production of learning and teaching resources for schools' reference. The experiences of trying out the learning and teaching in the classroom will be consolidated with resource materials to be disseminated in 2017.

5.13 For the updated Technology Education (S1-3) curriculum, relevant learning resources for all modules of Design & Technology (D&T) and Food and Textile Science have been developed and uploaded onto the EDB website. Besides, a learning and teaching resource package for programming is being developed.

5.14 Regarding the Mathematics curriculum, Seed Projects relevant to STEM education starts in the 2016/17 school year for the development and production of learning and teaching resources for primary and secondary schools.

5.15 For primary the General Studies curriculum, STEM-related resources packages on "Light, Sound & Electricity", "Forces and Simple Machines", "The Living World" and "Material Science" have been disseminated to teachers for reference. Additional packages of resources on other STEM-related topics will be developed to support the learning and teaching of the curriculum in the coming years. In addition, the Furniture and Equipment (F/E) List for General Studies has been updated and categorised with additional items for schools' reference. Teachers can refer to the EDB website for details.

5.16 For the primary level, a Computer Awareness Programme (CAP) of 8 modules has been revised and uploaded onto the web. Among the themes for learning activities, coding is newly introduced to enhance students' interest and innovation in the area of information technology.

5.17 EDB will review the printed textbooks and e-textbooks for the updated curricula to be submitted by publishers. This is to ensure the availability of quality textbooks for learning and teaching when the updated curricula are recommended for use in schools.

5.18 Two ETV programmes on promoting STEM education have been developed.  Other relevant programmes to support the learning and teaching of the updated curricula of the Science, Technology and Mathematics Education KLAs and General Studies will continue to be developed.

Cross-disciplinary resources development

5.19 A website to facilitate the promotion of STEM education has been developed and launched in September 2016.  It disseminates information about the promotion of STEM education, including upcoming events on professional development programmes, relevant student activities, STEM-related resources and other community resources for schools' reference.  The contents in the website will be updated regularly.

5.20 EDB is making good use of the existing assets/centres to support the different promotion strategies.  The Arts and Technology Education Centre (ATEC) in Lok Fu is being used more intensively for organising student activities and professional development programmes, e.g. on 3D-printing, microcontroller, laser cutting technology, etc. for teachers. The Young Achievers' Gallery (YAG) at the Kowloon Tong Education Services Centre has been renovated and re-opened serving for exhibiting school-based STEM projects.

**Chapter 6**

**Strategy 4    Enhancing Professional Development of Schools and Teachers**

In this chapter, we recommend enhancing the professional capacity of school principals, curriculum leaders and teachers in implementing STEM education holistically and effectively at school level.

*Proposals*

6.1    To organise symposia for curriculum leaders for all schools.

6.2    To continue to organise professional development programmes for middle managers and teachers in the coming school years to introduce the appropriate strategies for enhancing students' ability in 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.

6.3    To build communities of practice to enhance knowledge exchange within and across schools through different platforms (e.g. Professional Development Schools (PDS) Scheme of the Education Development Fund (EDF) and the Quality Education Fund Thematic Network (QTN)).

6.4    To increase teachers' exposure to cutting edge development in the science and technology fields through exchange with academics/partners in the territory and from the Mainland and overseas.

*Supportive View*

6.5    There has been strong support from stakeholders for enhancing professional development of school leaders and teachers.

*Major Concerns and Suggestions*

6.6    Some teachers were concerned about the workload involved in the promotion of STEM education in school.

6.7 Cross-KLA collaboration for whole-school planning and organising STEM-related activities is a challenge to teachers of the KLAs concerned. Some stakeholders showed concerns over teachers' readiness in the implementation of STEM-related activities.

6.8 Some secondary schools showed concern over the decline in the supply of Design and Technology (D&T), Design and Applied Technology (DAT) and Home Economics / Technology and Living teachers. For the primary level, quite a number of schools expressed concern over the expertise of some primary General Studies teachers, who may not be specialised in STEM-related disciplines.

6.9 Teachers considered that for effective promotion of STEM education at school-based level, good support from the school management is essential.

6.10 Some teachers suggested the development of communities of practice among schools to facilitate the professional capacity building of teachers.

6.11 Some respondents remarked that laboratory technicians in secondary schools should play a strengthened role in assisting the implementation of STEM-related learning activities for students.

### Final Recommendations

**The following actions would be adopted to strengthen professional capacity, knowledge transfer and cross-fertilisation among schools and teachers for building communities of practice on STEM education.**

6.12 With positive feedback gained from the symposia organised in July and November 2015, these large-scale events are found effective in promoting STEM education, in terms of capacity building for principals and curriculum leaders. EDB will continue to organise the symposia on a regular basis. The events also provide a platform of partnering with the school sector, relevant professional/STEM-related bodies for the promotion of STEM education among schools.

6.13 EDB will enhance the collaboration with STEM-related professional bodies, e.g. The Academy of Sciences of Hong Kong, Hong Kong Science and Technology Parks Corporation, to organise professional development programmes to update curriculum leaders and teachers from different perspectives about the effective means of promoting students' interest in STEM areas.

6.14 Various professional development programmes (PDPs) on promoting STEM education will be organised from 2016 onwards. For the primary level, different programmes will be arranged for school leaders/ Primary School Master (Curriculum Development) [PSM(CD)] and General Studies/Mathematics teachers respectively. For the secondary level, cross-KLA and KLA-based programmes will be organised. The target participants of cross-KLA programmes are school leaders, and teachers. The KLA-based programmes are for KLA coordinators/panel heads/middle managers/teachers. The contents of the PDPs for both primary and secondary levels will cover curriculum planning, pedagogy, assessment, knowledge enrichment, etc. and symposia, seminars, workshops, experience-sharing sessions and networking activities are some of the modes available.

6.15 In order to expand the learning communities for effective sharing and knowledge transfer, four schools with exemplary practices in learning and teaching and a good sharing culture in STEM education are designated as Professional Development Schools (PDS) for promoting STEM education in the 2016/17 school year. Each PDS provides intensive on-site support services to three partner schools to foster an interactive collaborative culture and to enhance the effectiveness of learning and teaching in STEM education through various exchange activities. Good practices generated from the schools will be disseminated. In the near future, Quality Education Fund Thematic Network (QTN) would also help promote good practices of STEM education in schools that can meet the quality criteria for dissemination.

6.16 With special reference to concerns of professional capacity in primary schools, programmes targeted at PSM(CD) and primary General Studies teachers on knowledge enrichment and pedagogies related to e-learning are being planned. Workshops, including those on enhancing students' computational thinking, will also be included to

better equip teachers of information technology with the necessary strategies and skills. More school network activities using the QTN are under planning.

6.17 Regarding the updating of job description of laboratory technicians for assisting the implementation of STEM-related activities in secondary schools, EDB will continue to provide STEM education related training programmes for laboratory technicians to facilitate the dissemination of good school-based experiences. Good practices will also be shared online for the reference of laboratory technicians.

**Chapter 7**

**Strategy 5    Strengthening Partnerships with Community Key Players**

This chapter discusses the strategies for engaging different stakeholders in the promotion of student learning in STEM areas.   It is recommended to further strengthen the partnerships with relevant stakeholders and maintain professional communities.

*Proposals*

7.1    To further enhance the communication with local curriculum advisory committees, as well as the school sector, for enhancing student learning in the KLAs of Science, Technology and Mathematics Education.

7.2    To strengthen the liaison with academics and practitioners who specialise in various science, technology, engineering and mathematics fields, and to explore the feasibility of collaborating with tertiary institutions and specialists in organising teacher training programmes and student learning activities.

7.3    To continue to strengthen the partnerships with professional bodies, tertiary institutions, and other government and non-government organisations in fostering synergy within the community for the promotion of STEM education among schools.

*Supportive View*

7.4    The majority of respondents supported the strengthening the partnerships with community key players and engagement of them for the promotion of STEM education.

*Major Concerns and Suggestions*

7.5    There were views about the need of strengthening cross-sector collaboration, e.g. partnership with relevant Bureaux, liaison with other fields, so as to capitalise more on community resources and support in promoting STEM education.

7.6 Some stakeholders remarked that the involvement of parents is required for promoting student learning in STEM-related areas.

*Final recommendations*

**EDB would adopt the following actions to synchronise the contributions from different community key players so as to enhance the promotion of STEM education in the territory.**

7.7 EDB will communicate with local curriculum advisory committees and the school sector regularly to seek their advice as well as to report on the progress of promoting STEM education, including the formation of the STEM network for engagement of relevant stakeholders.

7.8 To foster synergy within the community for the promotion of STEM education, EDB will strengthen the collaboration with various institutions, including government organisations and STEM-related bodies for different initiatives to ensure the projects are leveraging on the strengths and are complementary to each other. These include the "Computational Thinking and Coding Education" of Hong Kong Jockey Club Charities Trust and the "Enriched IT Programme in Secondary Schools by OGCIO of the Innovation and Technology Bureau. A list of community partners for promoting STEM education is at Appendix 4.

7.9 We will also strengthen the partnerships with tertiary institutions and professional bodies (e.g. British Council Hong Kong, Hong Kong Federation of Youth Groups and Hong Kong Association for Science and Mathematics Education) in various strategies.

7.10 We will also tap information about the future career opportunities (e.g. direction of STEM, job vacancies in different sectors) through liaison with related bodies/organisations/business firms/employers for reference in planning different strategies.

7.11 Updated information on STEM-related activities will be posted regularly at the STEM website for reference.

7.12 A closer liaison with parents-related organisations, e.g. Committee on Home-School Co-operation, will be made to enhance parents' understanding and engage them in various strategies.

**Chapter 8**

**Strategy 6  Conducting Review and Disseminating Good Practices**

We have proposed dissemination of good practices in organising learning activities as an effective means to facilitate the promotion of STEM education among schools.

*Proposals*

8.1  To conduct research and evaluation studies on the implementation of STEM education at school level, and to review the curricula as appropriate.

8.2  To continue to identify good school-based practices of implementing STEM education and consolidate experiences from schools in organising cross-disciplinary learning and teaching activities.

8.3  To disseminate evidence-based practices through professional development programmes and centres of excellence, e.g. Professional Development Schools (PDS) Scheme of the Education Development Fund (EDF).

*Supportive view*

8.4  Stakeholders generally agreed with the conduct of review and dissemination of good practices in STEM education.

*Major Concerns and Suggestions*

8.5  Some respondents expressed the view that STEM pilot schemes have to be carried out in a progressive manner.

*Final recommendations*

**EDB would adopt the actions below to review the development of STEM education, consolidate the good practices for dissemination and generate knowledge for transfer.**

8.6　More conscientious efforts would be made on identifying innovative pedagogies and student projects for dissemination and knowledge transfer. Apart from the PDS of the 2016/17 school year, the participating schools of the QTN would also help disseminate good practices not necessarily funded by the Quality Education Fund (QEF). It is hoped that these STEM centres would be located strategically to enhance accessibility to schools.

8.7　STEM education has been included in the "Priority Themes" of the QEF to encourage the education sector to apply for funding to foster innovativeness.

8.8　Experiences from STEM education related QEF Projects and other quality projects would be researched to generate new knowledge and insights so that they can be transferred to other situations.

8.9　To monitor the progress of implementation of STEM education, ongoing collection of feedback and evaluation will be conducted on the six strategies and on the impact of STEM education. Advisory curriculum committees, the school sector, tertiary institutions, professional organisations, parents and employers would be engaged in the process.

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# Summary of the Major Feedback collected during the Consultation on STEM Education

| Summary of Feedback | Sources | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | School Sector | | Parents | Professional Bodies | Tertiary Sector | STEM related Industry | General Public | Media | Others e.g. Legco Members, Political Parties, etc. |
| | Principals | Teachers | | | | | | | |
| **General Comments** | | | | | | | | | |
| **Supportive views** | | | | | | | | | |
| • The promotion of STEM education as a key emphasis of the ongoing renewal of the school curriculum is supported | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ |
| • Enhancing students' interest in learning through integrating and applying knowledge and skills across disciplines is supported | ✓ | ✓ | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| • Two recommended approaches for organising STEM-related learning activities are supported | ✓ | ✓ | | ✓ | ✓ | | | | |
| **Concerns/Suggestions** | | | | | | | | | |
| • STEM-related professional development programmes should be provided for school leaders and teachers | ✓ | ✓ | | ✓ | ✓ | | | | |
| • Issues about curriculum time and resources support | ✓ | ✓ | ✓ | | | | | | ✓ |
| **Six proposed strategies for promoting STEM education** | | | | | | | | | |
| **(I) Renewing the Curricula of Science, Technology and Mathematics Education KLAs** | | | | | | | | | |
| **Supportive views** | | | | | | | | | |
| • The direction of the updates of the relevant curricula is supported | ✓ | ✓ | | ✓ | ✓ | | | | |
| • Supporting that STEM education should start from the primary level | ✓ | ✓ | | ✓ | ✓ | ✓ | | | |
| • Provision of hands-on learning activities for students to solve authentic problems is essential | ✓ | ✓ | | ✓ | ✓ | | | ✓ | |

| Concerns/Suggestions | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| • Insufficiency of lesson time | ✓ | ✓ | ✓ | | | | | | | ✓ |
| • The interface between primary and secondary levels should be strengthened | ✓ | ✓ | ✓ | | | | | | | ✓ |
| • Concern about the alignment between Mathematics and Science curricula | ✓ | ✓ | | | ✓ | | | | | |
| • Issue about embracing learner diversity | ✓ | ✓ | | | ✓ | ✓ | ✓ | | | ✓ |
| • Issue about student assessment | ✓ | ✓ | | | | | | | | |
| • Concern about the updating of the curricula related to information technology | ✓ | ✓ | ✓ | | | | | | ✓ | ✓ |
| **(II)  Enriching Learning Activities for Students** | | | | | | | | | | |
| **Supportive views** | | | | | | | | | | |
| • The enrichment of learning activities for students are strongly supported | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | | | |
| **Concerns/Suggestions** | | | | | | | | | | |
| • Both primary and junior secondary students have more room to engage in STEM-related activities | ✓ | ✓ | | ✓ | ✓ | | | | | |
| • There is a need to strengthen the school-based support for schools in planning and organising STEM-related activities | ✓ | ✓ | | | ✓ | | | | | |
| • Organising student activities with elements of life planning is suggested | ✓ | ✓ | | ✓ | ✓ | | | | ✓ | ✓ |
| • Some students might have difficulty in squeezing time to engage in STEM-related activities | ✓ | ✓ | | | | | | | | |
| • Enhanced efforts should be made to encourage students with different capabilities and backgrounds to participate in STEM-related activities | ✓ | ✓ | | ✓ | | ✓ | ✓ | | | |
| **(III)  Providing Learning and Teaching Resources** | | | | | | | | | | |
| **Supportive views** | | | | | | | | | | |
| • The provision of learning and teaching resources for teachers' reference is strongly supported | ✓ | ✓ | | ✓ | ✓ | | | | | |

| Concerns/Suggestions | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| • Request for the provision of other resources support (e.g. additional manpower, financial support) to schools | ✓ | ✓ | | | | | | ✓ | | ✓ |
| • Making use of a wide variety of tools and kits (e.g. free tools on web) to facilitate STEM education is suggested | | | | | | ✓ | | | | |

**(IV) Enhancing Professional Development of Schools and Teachers**

| Supportive views | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| • The enhancement of professional development programmes for school leaders and teachers is strongly supported | ✓ | ✓ | | ✓ | ✓ | | | | | ✓ |

| Concerns/Suggestions | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| • Workload of teachers | ✓ | ✓ | ✓ | | | | | ✓ | ✓ | ✓ |
| • Challenge on cross-KLA collaboration | ✓ | ✓ | | | | | | | | |
| • Shortage of D&T (Design and Technology), DAT (Design and Applied Technology), and Home Economics / Technology and Living teachers | ✓ | ✓ | | | | | | | | |
| • Issue about subject expertise of teachers at the primary school level | ✓ | ✓ | ✓ | | ✓ | | | | | ✓ |
| • Issue about support provided by laboratory technicians in secondary schools | ✓ | ✓ | | | | | | | | |
| • Support from the school management is essential | ✓ | ✓ | | | | | | | | |

**(V) Strengthening Partnerships with Community Key Players**

| Supportive views | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| • The proposal of strengthening the collaboration with community key players is supported | ✓ | ✓ | | ✓ | | ✓ | | | | ✓ |

| Concerns/Suggestions | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| • Parents' participation is important | ✓ | ✓ | ✓ | | | | | | ✓ | |
| • Cross-sector collaboration (e.g. cross-field partnership) is suggested | | | | ✓ | | ✓ | | | | |
| • STEM career prospects should be introduced to students | ✓ | ✓ | | ✓ | | | | | ✓ | ✓ |

| (VI) Conducting Review and Disseminate Good Practices | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Supportive views** | | | | | | | | | |
| • The proposal of conducting review and disseminating good practices is generally supported | ✓ | ✓ | | | | | | | |
| **Concerns/Suggestions** | | | | | | | | | |
| • STEM pilot schemes have to be carried out in a progressive manner | ✓ | ✓ | | | | | | | |

**Summary of the School Survey Results on the
Promotion of STEM Education and the Curriculum Renewal of the
Science, Technology and Mathematics Education Key Learning Areas**

**Background**

To solicit views from the school sector on the promotion of STEM education and the curriculum renewal of Science, Technology and Mathematics Education KLAs, EDB conducted a school survey from November 2015 to January 2016 for secondary and primary schools, including special schools. A total of 2 584 returns were received, representing a response rate of 81.9%.

[Number of returns: Science Education (869), Technology Education (857), Mathematics Education (858)]

**Survey results**

**(A) On Promotion of STEM Education**

*Whether the respondents agreed:*

1. The promotion of STEM education is introduced as a key emphasis of the ongoing renewal of the school curriculum with the focus on unleashing students' potential and developing their capacity to innovate by enhancing their creativity and problem solving skills, as well as their interest in learning through integrating and applying knowledge and skills across disciplines of Science, Technology and Mathematics Education KLAs.
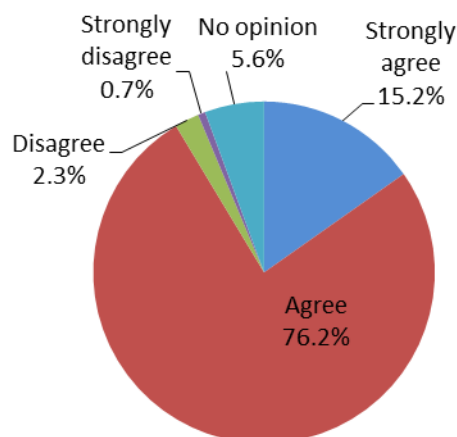
2. Recommended approaches for organising STEM-related learning activities:
   (i) Approach 1 - Learning activities based on topics of a KLA for students to integrate relevant learning elements from other KLAs

Strongly disagree 0.5%

No opinion 4.2%

Strongly agree 12.3%

Disagree 4.8%

Agree 78.2%
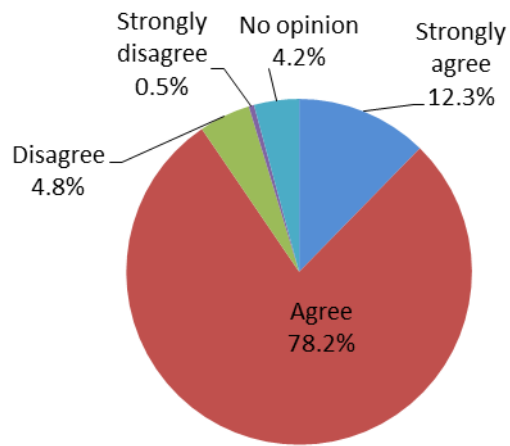
   (ii) Approach 2 - Projects for students to integrate relevant learning elements from different KLAs
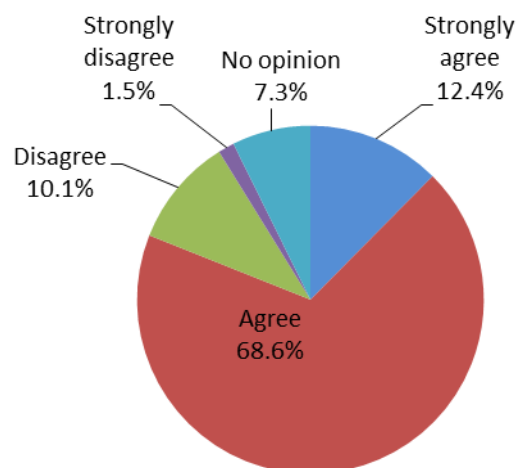
Strongly disagree 1.5%

No opinion 7.3%

Strongly agree 12.4%

Disagree 10.1%

Agree 68.6%

3. Proposed strategies for promoting STEM education:

   (i) Renewing the curricula of Science, Technology and Mathematics Education KLAs

Strongly disagree 1.0%
No opinion 8.1%
Strongly agree 17.3%
Disagree 6.2%
Agree 67.3%

   (ii) Enriching learning activities for students

Strongly disagree 0.3%
No opinion 4.3%
Strongly agree 20.7%
Disagree 2.3%
Agree 72.4%
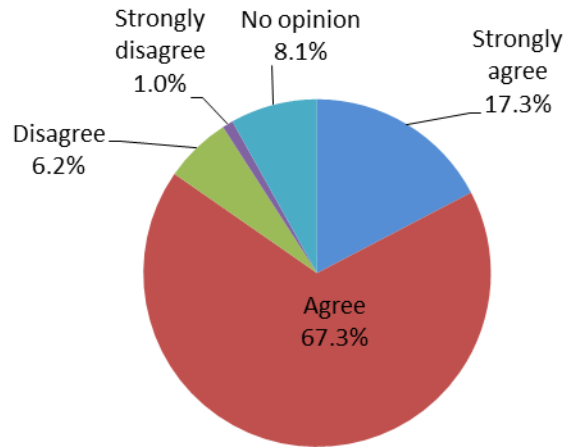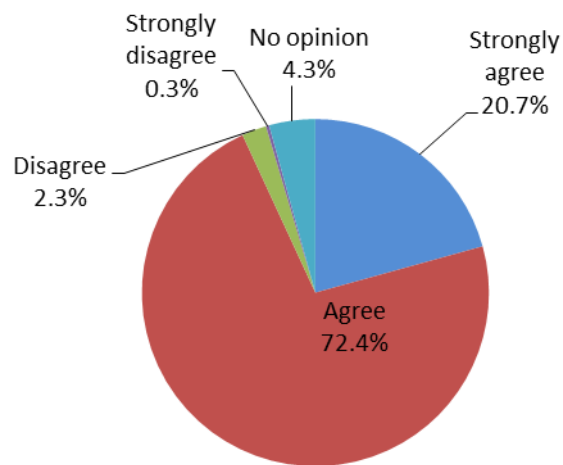
(iii)    Providing learning and teaching resources
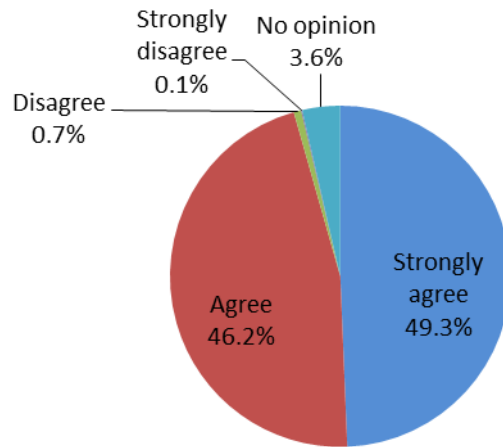


(iv)    Enhancing professional development of schools and teachers
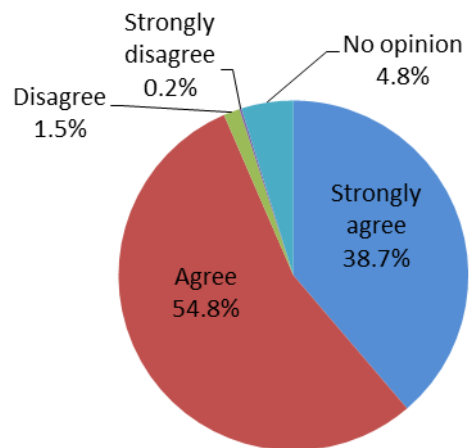
(v)    Strengthening partnerships with community key players
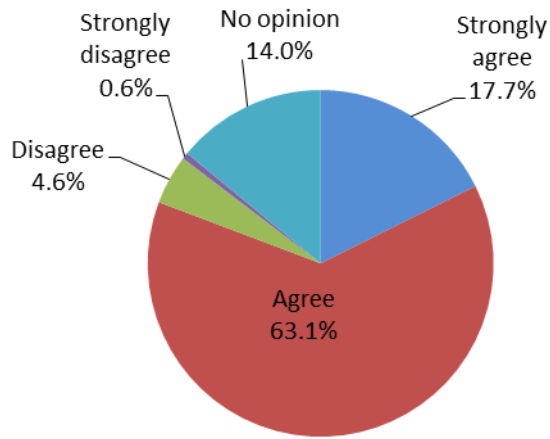


(vi)    Conducting review and disseminate good practices
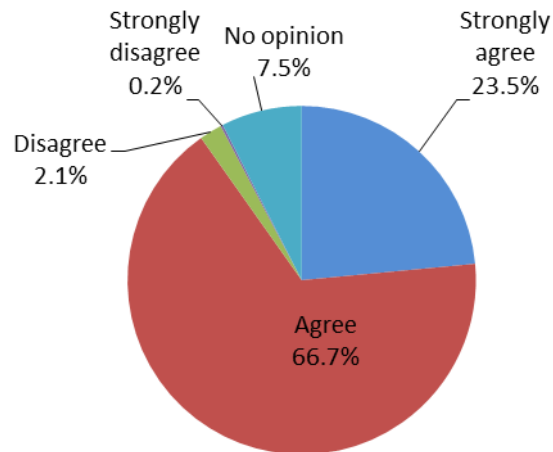
## (B) On Renewal of the Science Education KLA Curriculum

*Whether the respondents agreed:*

1. (i) The updated curriculum aims of science education.
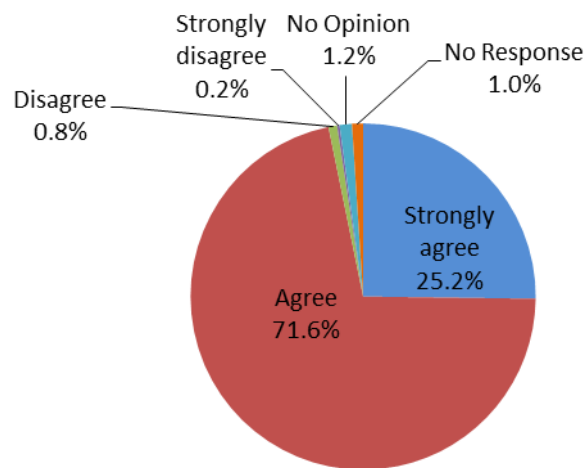


(ii) The updated curriculum emphases of science education.
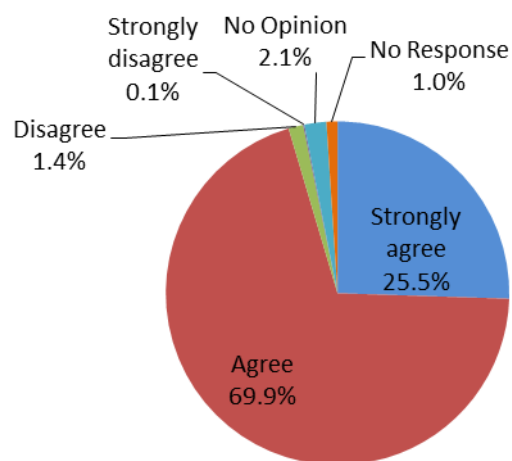
## 2. Updated curriculum framework of science education

(i) Maintaining the six strands of science education
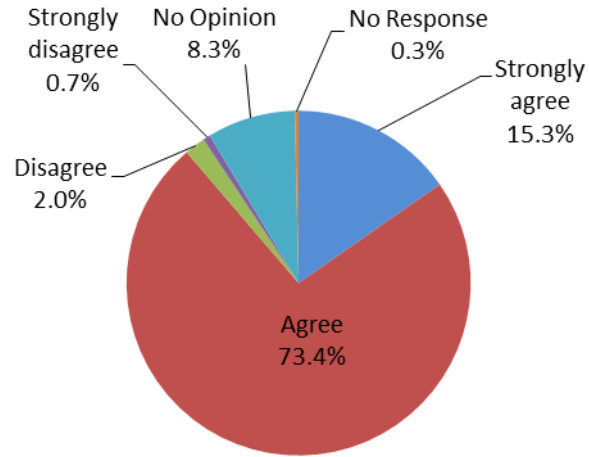


(ii) Highlighting the importance of scientific literacy
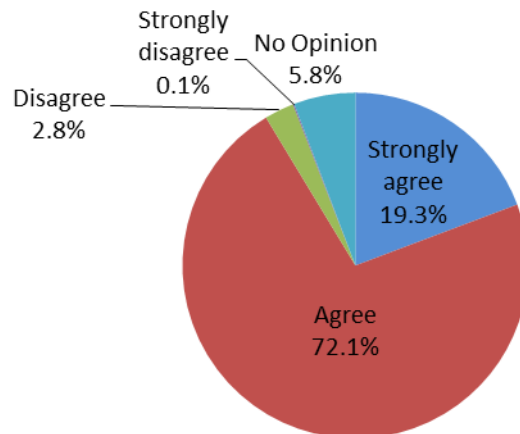
(iii)　Promoting STEM education – ability to integrate and apply knowledge and skills

Strongly disagree 0.1%
No Opinion 6.3%
No Response 0.2%
Strongly agree 19.1%
Disagree 2.4%
Agree 71.8%
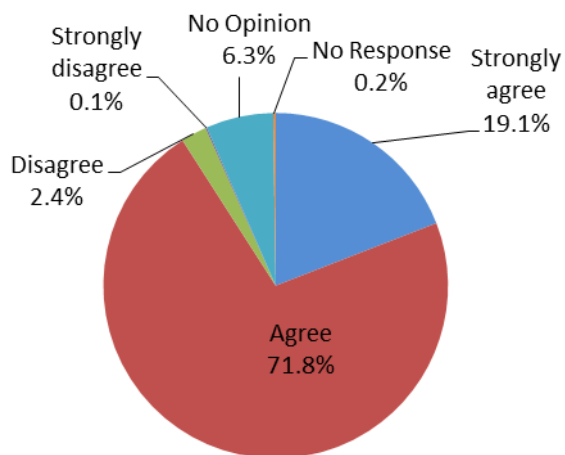
(iv)　Including other updated elements of the ongoing renewal of the school curriculum

Strongly disagree 0.2%
No Opinion 10.2%
No Response 0.6%
Strongly agree 12.0%
Disagree 4.0%
Agree 73.0%
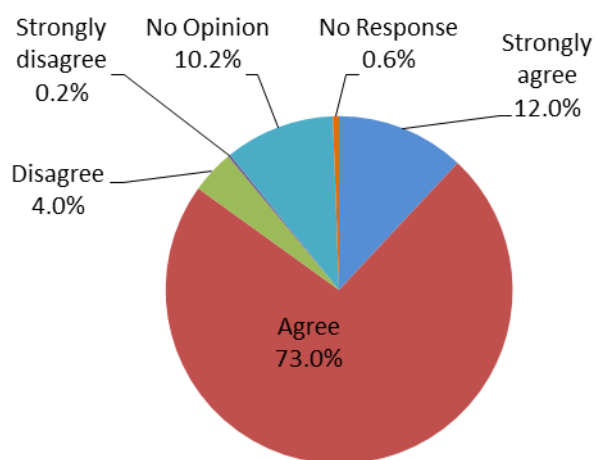
3.  The holistic curriculum development (to enhance the vertical continuity and lateral coherence) is important in the Science Education KLA
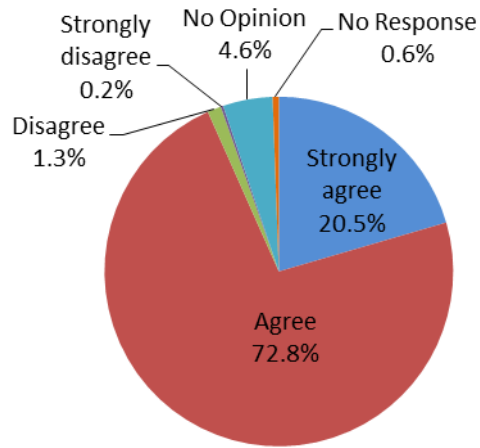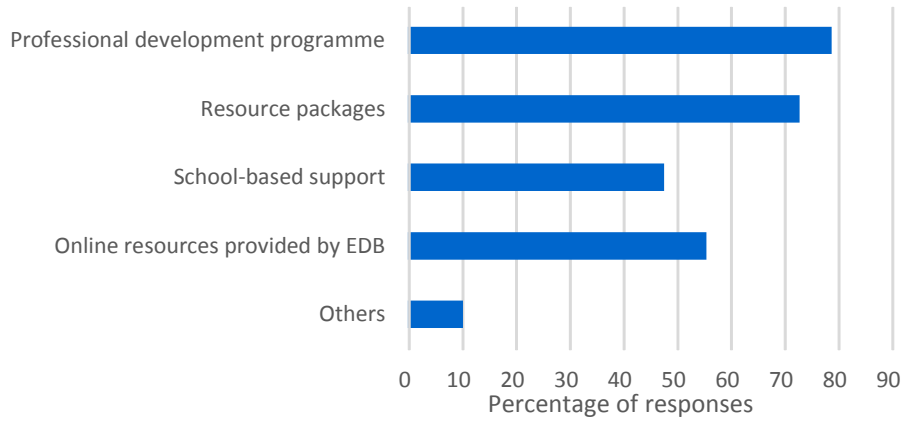
4. (i) Area(s) that schools require support most:
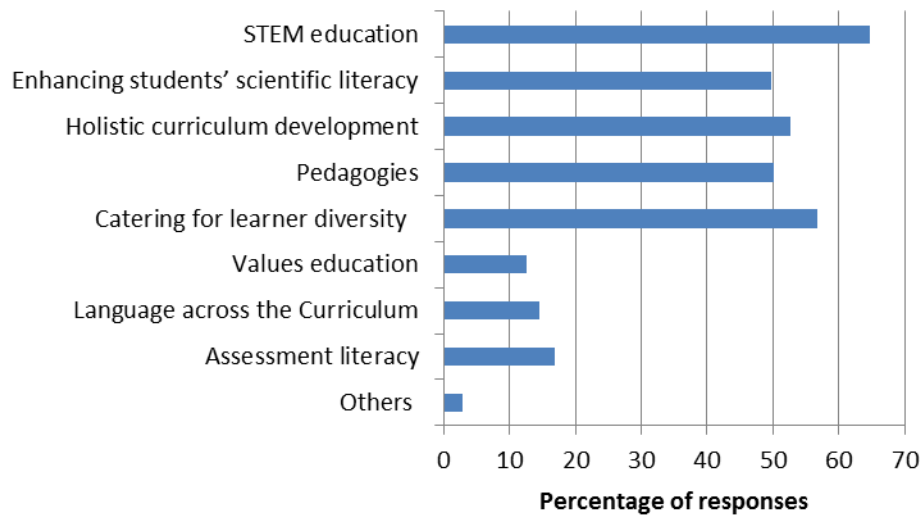


(ii) Support measures that best address the needs and concerns of schools in incorporating the major areas for updates in the school-based science education curriculum are:
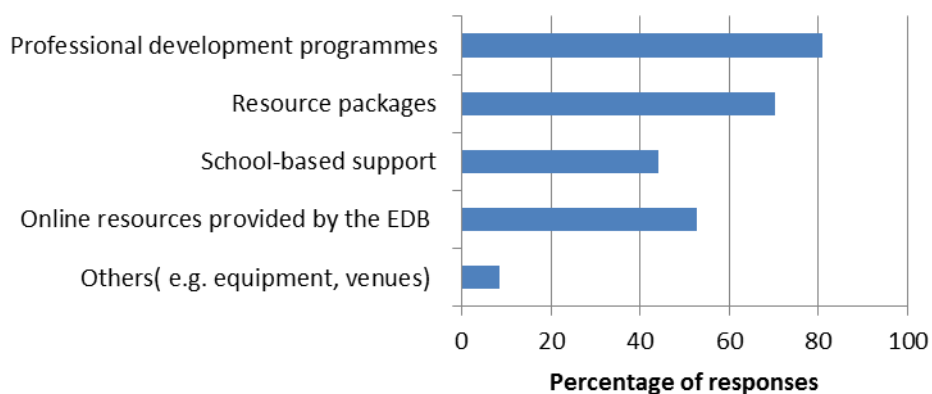
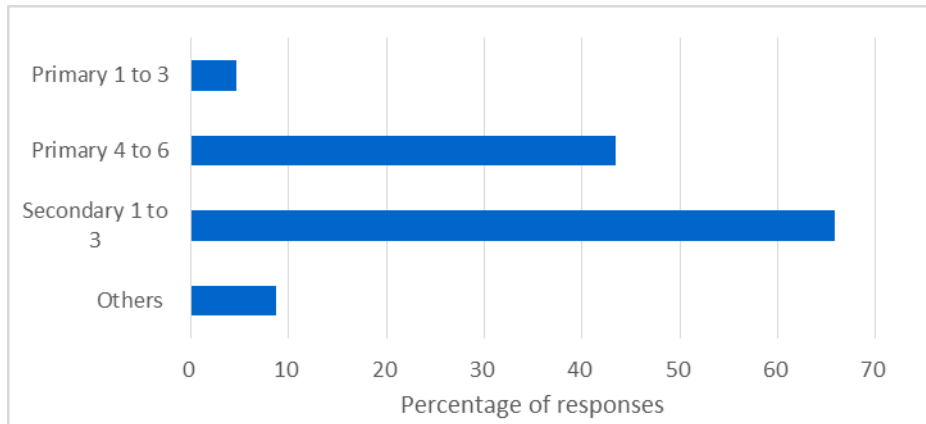**(C) On Renewal of the Technology Education KLA Curriculum**

*Whether the respondents agreed:*

**1.** The following focuses for the ongoing renewal of the school curriculum can be integrated into the Technology Education KLA curriculum through tasks

   (i) Promoting STEM education

No opinion 9.6%
No response 0.4%
Strongly disagree 0.2%
Disagree 2.6%
Strongly agree 18.6%
Agree 68.7%
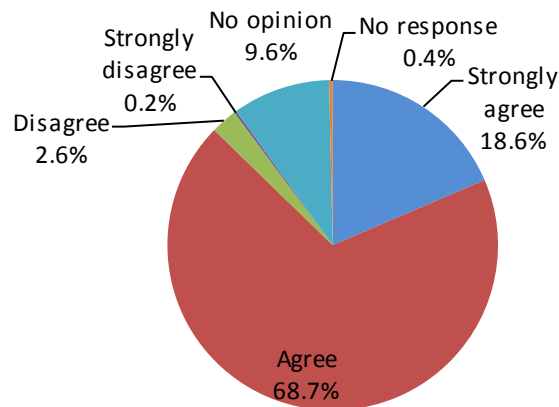
   (ii) Strengthening information literacy

Strongly disagree 0.2%
No opinion 6.5%
No response 0.5%
Disagree 2.0%
Strongly agree 23.7%
Agree 67.1%
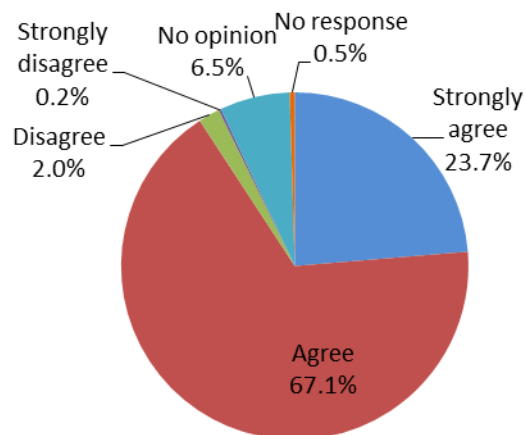
(iii) Strengthening language across the curriculum
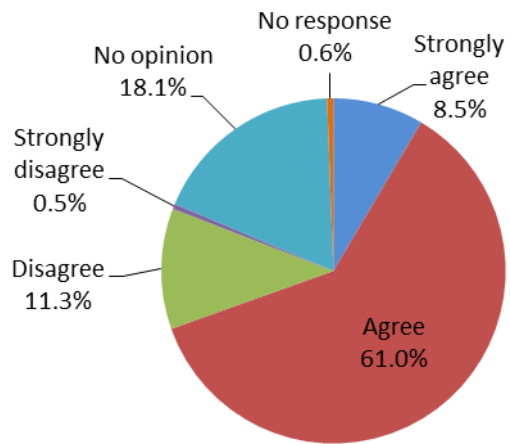


(iv) Promoting values education
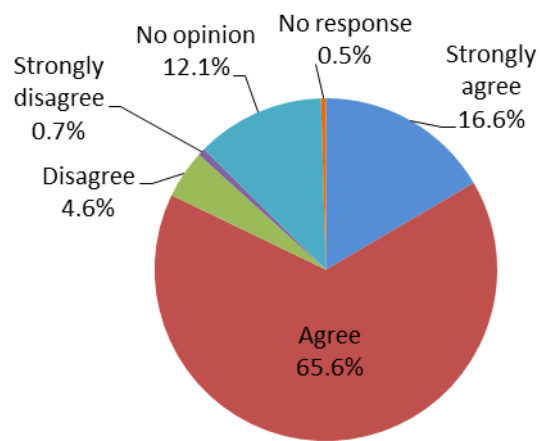
**2.** The following areas for updates are to be put forth in the Technology Education KLA Curriculum Guide

    (i)    Integrative learning and application skills of students through STEM education
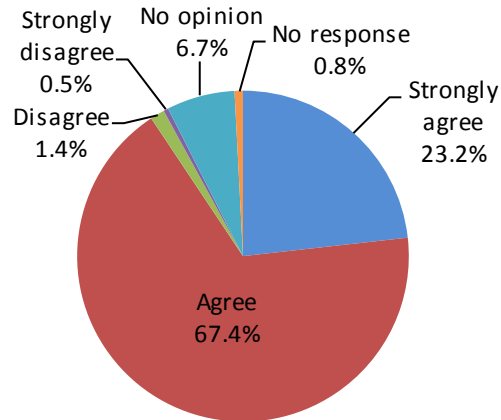


    (ii)    Generic skills, values education (including Basic Law education), language across the curriculum and information literacy
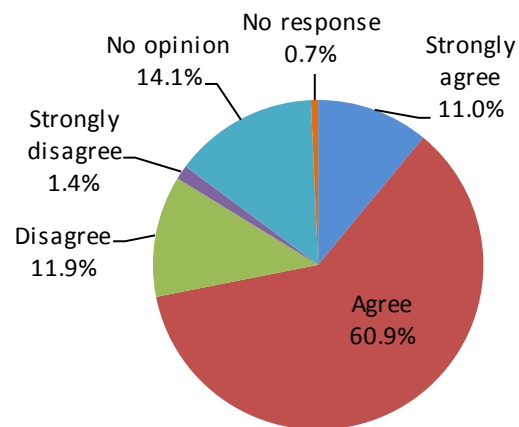
(iii)    e-Learning
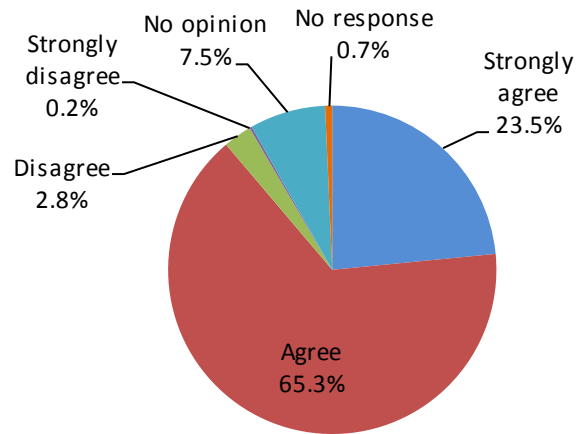


(iv)    Holistic school-based Technology Education curriculum planning

(v)    Catering for learner diversity
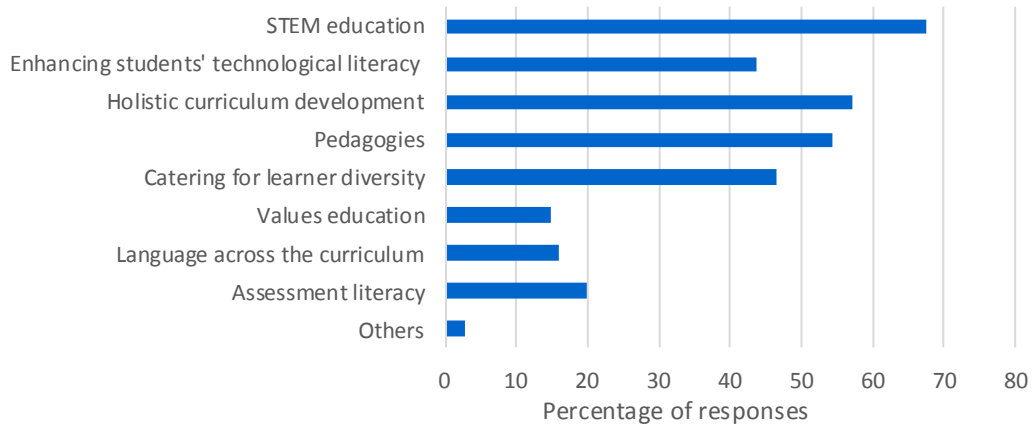


Strongly disagree 0.0%
No opinion 9.3%
No response 0.8%
Strongly agree 24.3%
Disagree 3.0%
Agree 62.5%

3.    (i)    Area(s) that schools require support most:



| | STEM education |
| | Enhancing students' technological literacy |
| | Holistic curriculum development |
| | Pedagogies |
| | Catering for learner diversity |
| | Values education |
| | Language across the curriculum |
| | Assessment literacy |
| | Others |

Percentage of responses

(ii)   Support measures that can best address the needs and concerns of schools in incorporating the major areas for updates in the school-based technology education curriculum:



**4**.   (i)   Levels at which programming (including coding) is taught in schools:
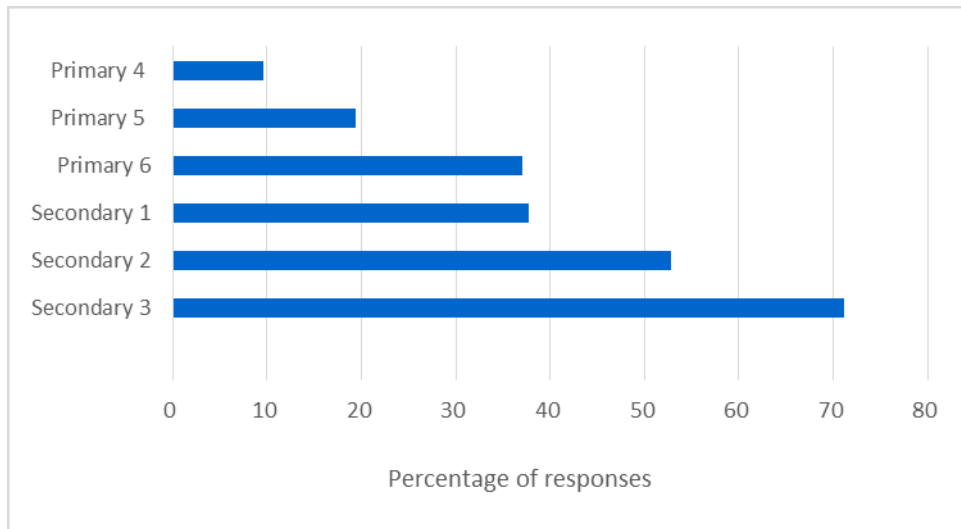


*\* Primary 4- 6 figures are based on responses from primary schools and special schools, while Secondary 1-3 figures are based on responses from secondary schools and special schools.*

(ii)    Levels at which programming (including coding) should be taught in schools in Hong Kong:



(iii)   Computer teachers in schools are capable of teaching programming (including coding) in classes.
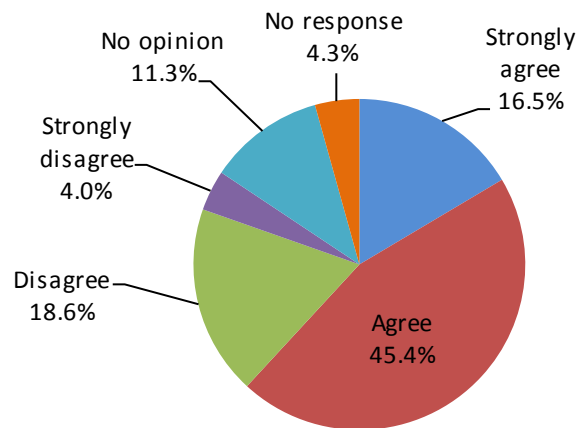
## (D) On Renewal of the Mathematics Education KLA Curriculum

*Whether the respondents agreed:*

1.  The overall curriculum aims of the Mathematics Education KLA should remain unchanged in the next five to ten years.
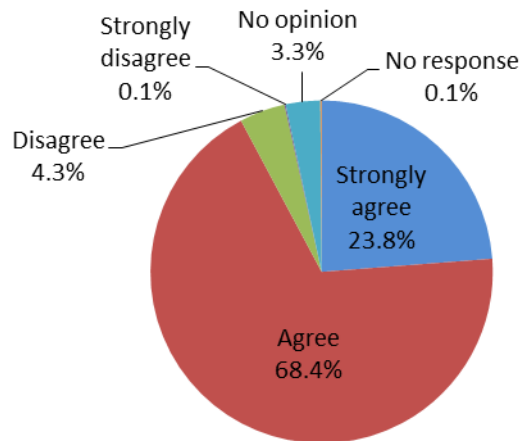


2.  The followings are important issues that should be addressed in the coming holistic review of Mathematics curriculum.

(i) The content of Enrichment Topics of the primary and junior secondary Mathematics curricula
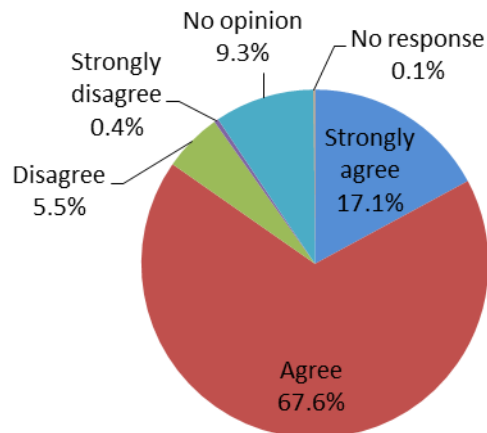
(ii) The setting of Spare Periods in the primary and junior secondary Mathematics curricula
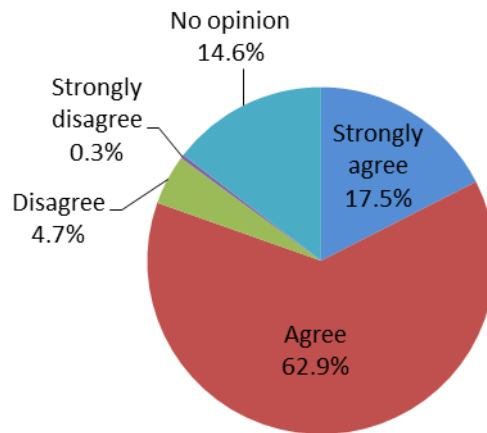


(iii) The teaching sequence of topics for better interface of learning and teaching between Key Stages
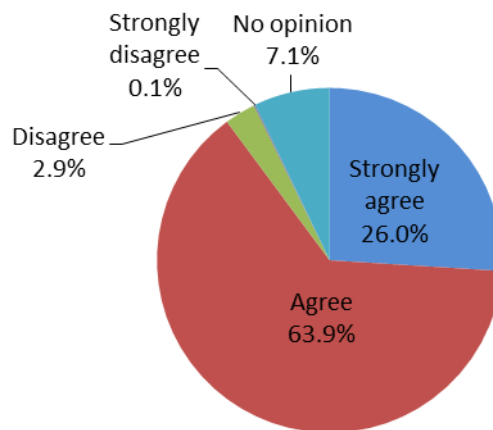
(iv) The teaching sequence and depth of treatment of topics for providing better support to the learning of other KLAs and subjects
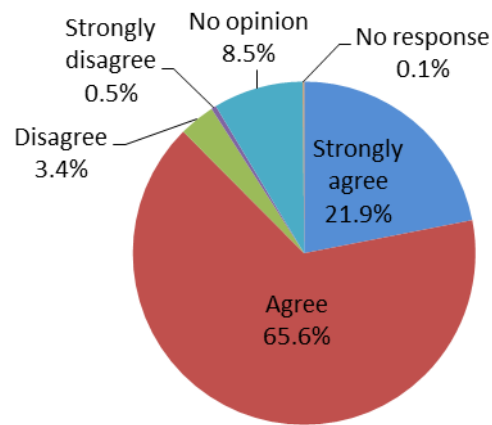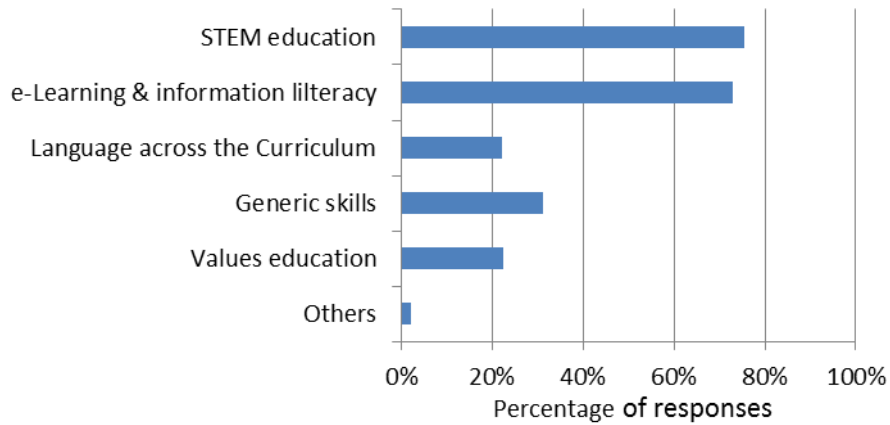


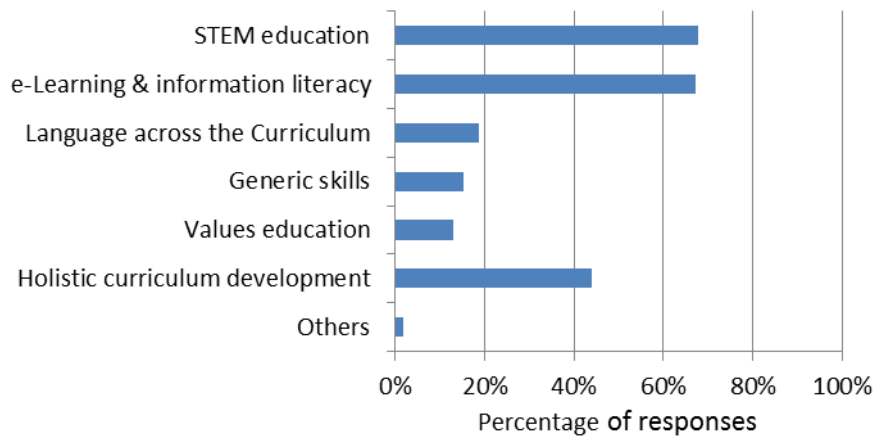(v) The strengthening of the learning and teaching of Data Handling
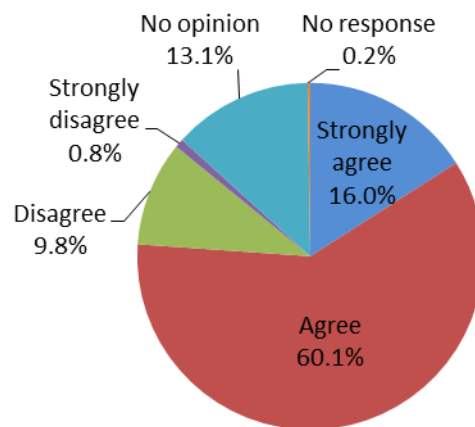
3. Areas for updates to be put forth in the Mathematics Education KLA Curriculum Guide (2016) that schools require information and explanation from the curriculum guide most are:



4. (a) Area(s) that schools require support most are:

(b)   Support measures that can best address the needs and concerns of schools in incorporating the major areas for updates in the school-based mathematics education curriculum are:
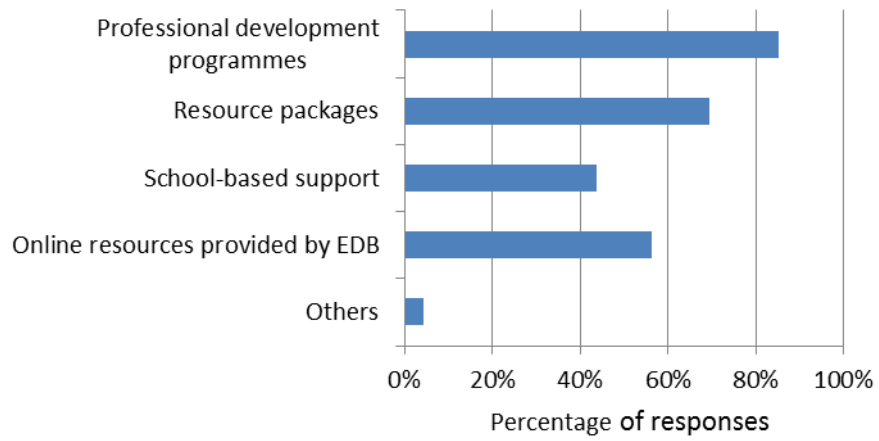
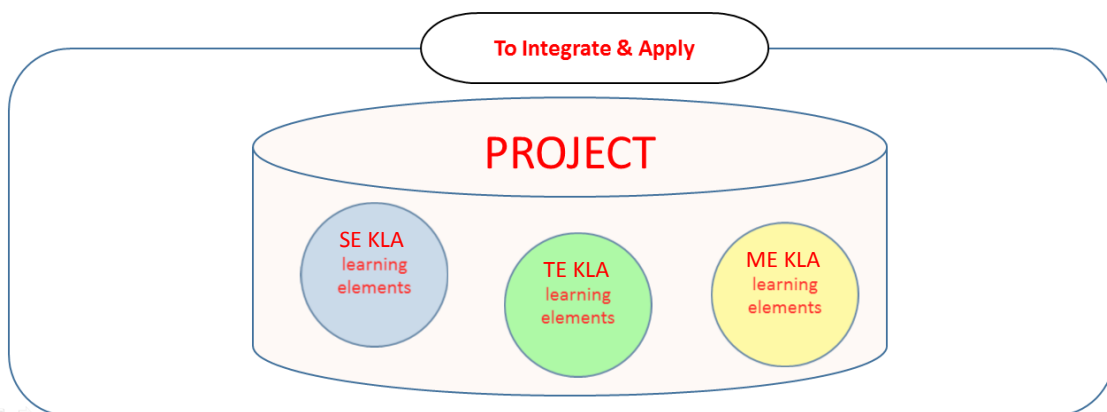# Recommended Approaches for Organising Learning Activities on STEM Education

## Approach One

*Learning activities based on topics of a KLA for students to integrate relevant learning elements from other KLAs*
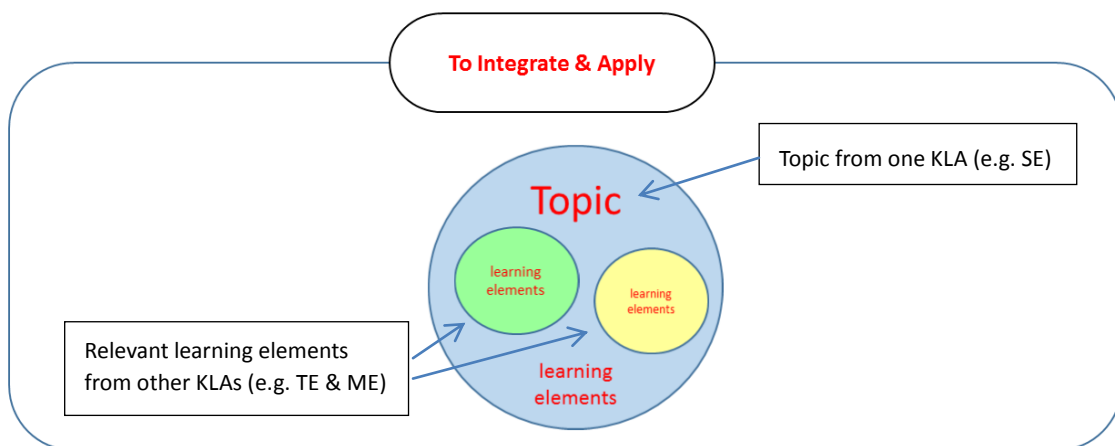


## Approach Two

*Projects for students to integrate relevant learning elements from different KLAs*

# Major Community Partners in Promotion of STEM Education

- AFCD Lions Nature Education Centre

- Agriculture, Fisheries and Conservation Department

- Arts & Technology Education Centre

- Association of I.T. Leaders in Education

- British Council Hong Kong

- Caritas Chan Chun Ha Field Studies Centre

- Census and Statistics Department

- City University of Hong Kong

- CLP Power Hong Kong Limited

- Committee on Home-School Co-operation

- Environmental Protection Department

- Ho Koon Nature Education cum Astronomical Centre (Sponsored by Sik Sik Yuen)

- Hong Kong Association for Science and Mathematics Education

- Hong Kong Association of Careers Masters and Guidance Masters

- Hong Kong Baptist University

- Hong Kong Education City Limited

- Hong Kong Institute of Vocational Education

- Hong Kong New Emerging Technology Education Association

- Hong Kong New Generation Cultural Association

- Hong Kong Observatory

- Hong Kong Productivity Council

- Hong Kong Science and Technology Parks Corporation

- Hong Kong Science Museum

- Hong Kong Space Museum

- Hong Kong Statistical Society

- Hong Kong Technology Education Association

- Hong Kong Wetland Park

- Innovation and Technology Bureau

- Jockey Club Museum of Climate Change (MoCC)

- Kadoorie Farm & Botanic Garden

- Ocean Park Academy Hong Kong

- Our Hong Kong Foundation

- Sik Sik Yuen Biotechnology Mobile Laboratory

- STEM Initiative Hong Kong

- The Academy of Sciences of Hong Kong

- The Chinese University of Hong Kong

- The Education University of Hong Kong

- The Hong Kong Academy for Gifted Education

- The Hong Kong Association for Computer Education

- The Hong Kong Federation of Youth Groups

- The Hong Kong Institution of Engineers

- The Hong Kong Jockey Club Charities Trust

- The Hong Kong Polytechnic University

- The Hong Kong University of Science and Technology

- The Institution of Engineering and Technology (Hong Kong)

- The Open University of Hong Kong

- The University of Hong Kong

- The Women's Foundation

- Water Supplies Department

- World Wildlife Fund Hong Kong