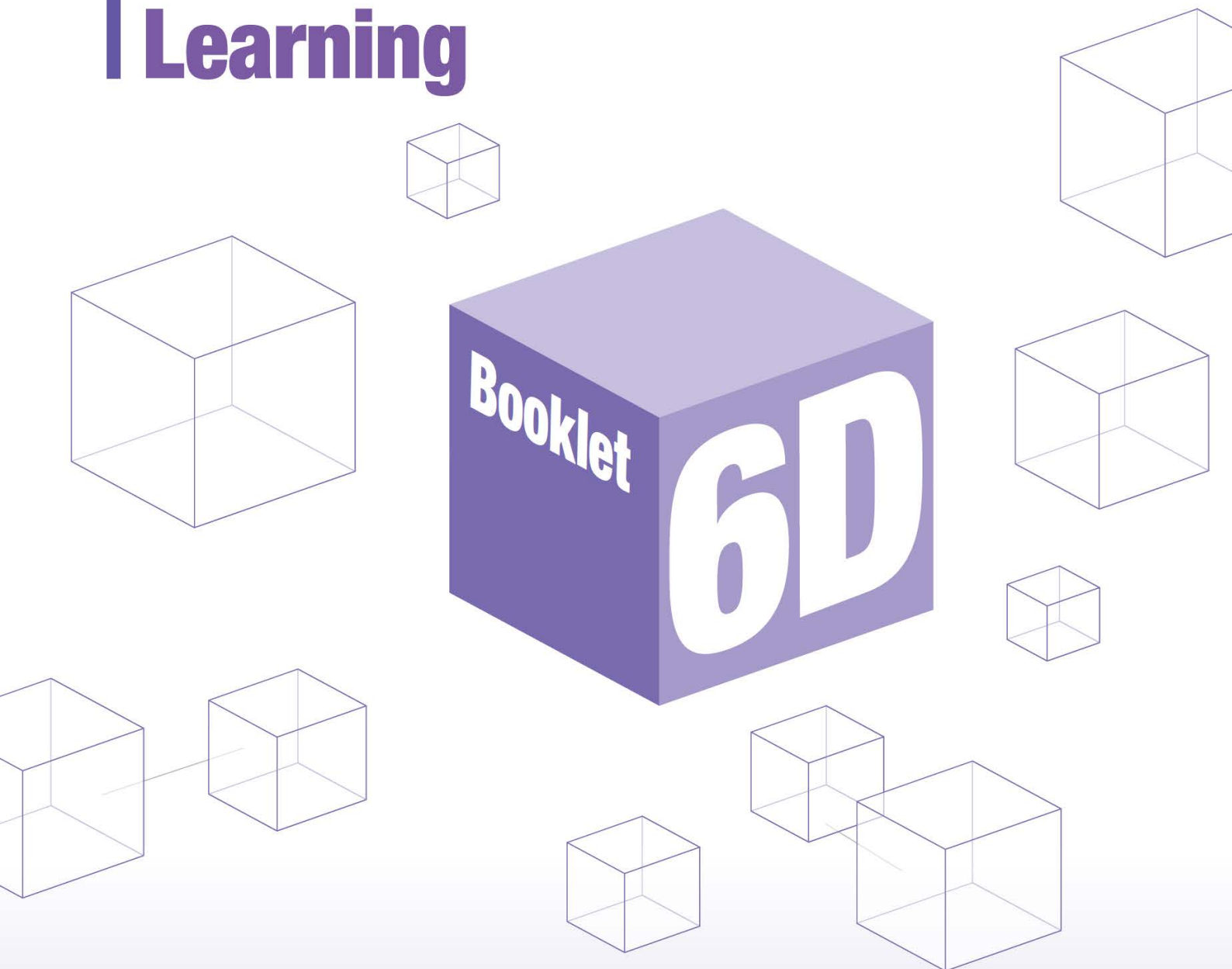


Information Technology for Interactive Learning: Towards Self-directed Learning



**Booklet 6D Information Technology for Interactive Learning:
Towards Self-directed Learning**

This is Part D of Booklet 6, one of the 11 booklets in the Secondary Education Curriculum Guide. Its contents are as follows:

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6D.1 Background

- Information Technology (IT) for Interactive Learning has been one of the Four Key Tasks as a strategy to develop students' learning to learn capabilities within and across Key Learning Areas (KLAs) since 2001. Teachers have successfully undergone a paradigm shift in using relevant digital resources, and designing and adopting a variety of activities to harness the advantage of IT in promoting interactive learning. The Internet is also popularly used to facilitate learning and teaching.
- IT has developed rapidly over the past decades and is prevalent in every facet of life. Advances in technology, in particular the growing accessibility of mobile technology, have brought about changing modes of learning and teaching. To prepare students for the challenges in a knowledge-based, technologically advanced and increasingly globalised world, it is necessary to promote self-directed learning in the school curriculum development to enhance students' sense of control and metacognitive skills.
- When using IT for learning and teaching, it is important to set clear objectives, adopt effective pedagogies and design meaningful tasks that promote student learning. Effective use of IT could help provide a conducive environment to unleash the potential of students to excel through self-directed learning, i.e. developing the skills to take initiative and responsibility for learning with or without the assistance of others. Students who become self-directed learners are able to identify their learning needs, formulate goals, and choose resources and strategies for learning.
- In the ongoing renewal of the school curriculum, the key task of IT for Interactive Learning is updated as **Information Technology for Interactive Learning: Towards Self-directed Learning (IT for SDL)**. Building on the solid experience acquired over the last decade on promoting IT for interactive learning, IT for SDL aims to foster the development of students' learning to learn capabilities through a better use of IT and e-learning resources. It could be used as a strategy to facilitate the implementation of major renewed emphases (MRE) in the ongoing renewal of the school curriculum such as STEM education, IT in Education (ITE), and Language across the Curriculum (LaC).
- The advancement of technology creates an environment conducive to engaging students in connection to the vast amount of information on the

Internet and enables students to communicate and collaborate with their peers, teachers and even people in different parts of the world anytime and anywhere. With the increasingly widespread use of information and media technology, schools have to put due consideration on enhancing students' information literacy so that students become effective and ethical users of information and IT.

- The goal of the Fourth Strategy on IT in Education (ITE4), which was formally launched in the 2015/16 school year, is unleashing the learning power of all students to learn to learn and to excel through realising the potential of IT in enhancing interactive learning and teaching experiences. To achieve this goal, a holistic approach is adopted to implement the six supporting actions (*please refer to the Education Bureau (EDB) website on ITE4 available at: www.edb.gov.hk/ited/ite4 for details*). In three years' time from the 2015/16 school year, schools have smooth and stable Wi-Fi coverage in the classrooms to facilitate the use of mobile computing devices for e-learning. Other measures such as setting up of Centre of Excellence (CoE) schools for sharing of good practices in e-learning, reviewing the school curriculum, enhancing the e-learning resources and building up the professional leadership and capacity of school teachers are also in the pipeline.



6D.2 Purposes of the Booklet

- To introduce the features of IT and explore how IT can be harnessed to enhance learning and teaching effectiveness
- To provide an overview of the factors schools should consider when formulating the whole-school curriculum planning for IT
- To provide suggestions on how to address students' diverse needs when adopting IT

6D.3 Using IT for Enhancing Student Learning

Harnessing IT in the school curriculum is the key to strengthening and facilitating learning and teaching in the 21st century. With the specific nature of IT, students will be motivated to learn and become self-directed learners with better problem solving skills, collaboration skills, computational thinking skills as well as creativity and innovation. They will also be empowered to realise their potential and some may develop a career interest in IT.

6D.3.1 Enhancing Collaborative and Self-directed Learning

- With the advancement of technology, schools have uploaded massive e-learning resources to online platforms to facilitate self-directed learning. Online platforms allow students to learn at their own pace and exhibit their learning achievements. They also enable students to deepen their learning and enhance their engagement in learning through sharing and collaboration which bring in wider perspectives in problem solving. Student learning is optimised through experiencing a blend of collaborative and individual work.
- Schools may provide opportunities for students to tap Internet resources efficiently to develop collaborative and self-directed learning capabilities. Schools may also adopt “flipped classroom”¹ as a strategy to encourage students to take up their own responsibility to learn.

¹ “Flipped classroom” is a learning model in which students watch videos at home and then engage in face-to-face discussions during the lesson time at school. Students have access to online tools and resources anytime, work at their own pace and adopt their preferred style of learning at home, while teachers have more time to interact with students individually and allow students to work collaboratively in class. This approach supports students’ self-directed learning.

Example 1: Using an Online Platform to Foster Collaborative Learning (CL) and Self-directed Learning (SDL)

Task

- Students work in groups to conduct a project on “Climate Change” and make suggestions on the responsibility as citizens.

CL and SDL

- CL: Students work out a schedule to complete the assigned project and share it on the calendar of an online platform.
- SDL: Individual students set and share their own schedules for task completion with reference to the overall schedule.
- SDL and CL: Individual students take up the responsibility to search for information about climate change from the Internet, collect useful data from their living environment through surveys, and identify appropriate tools to process the data. Then they share their resources and findings on the online platform.
- CL: Students are free to make reference to and comment on others’ work and resources. They also reflect and make suggestions on improving their own work, and share their views on the responsibility as citizens through online and face-to-face discussions.

Impact on student learning

- Capitalising on technology, students are placed at the centre of learning to find solutions to real life problems. This approach enhances students’ development of collaborative and self-directed learning capabilities. Individual students identify their roles in the group project, take up their responsibility to learn, and make effective use of technology to search for information and interact with other group members. In the process, students identify their learning needs and choose resources and strategies for learning. Technology plays a key role in facilitating students’ search for information, as well as collaboration and interactions with their peers.

Example 2: Flipped Classroom in Mathematics

- A Mathematics teacher introduces flipped classroom to his class by creating instructional videos according to his teaching schedule and uploading them to an online platform for students' access. Before the lessons, students have to watch the videos and answer some questions. The teacher then checks their performance and revises his teaching objectives according to students' needs. Discussion worksheets are given to students for completion in groups during lesson time.

Impact on student learning

- This approach facilitates students' self-directed learning and expands their learning time. When students watch the videos created by their teacher before the lessons, they can work at their own pace and adopt their own style of learning. This approach allows the teacher to focus on interacting with individual students and to engage all students in collaborative group work during lesson time. In this way, the teacher can cater for learner diversity and collect data effectively for timely adjustment of the teaching objectives, strategies as well as provision of quality feedback to students.

6D.3.2 Learning beyond the Limitations of Time and Space

- With the implementation of ITE4, schools can construct their Wi-Fi environment, acquire mobile computing devices for conducting e-learning inside and outside schools, and adopt the use of apps, e-learning resources and e-textbooks in their curricula to enhance learning and teaching effectiveness.
- Mobile computing devices are presented as more flexible alternatives to laptops and desktops due to their greater portability and access to apps with built-in social features which enable students to share their questions and findings with each other in real time. Students can also leverage the built-in cameras, recording microphones and other tools in their mobile phones or tablets to do fieldwork and create presentations with rich media. This is

especially convenient for work done outside the classroom as students can record interviews, collect data for experiments, etc.

Example 3: Mobile Learning in a Geography Field Trip

- To deepen students' understanding of the geomorphology and geology of Hong Kong, a Geography teacher takes his students to Cheung Chau for a field trip.
- Before the field trip, students install an app in their mobile learning devices such as smartphones and tablets. During the field trip, questions pre-set by the teacher using the app will pop up according to students' physical location. Students have to observe from their environment in order to answer the questions. Students also use their mobile learning devices to search information online, take photos, record their observations, and upload their findings and photos to share with their peers and teachers.

Impact on student learning

- Mobile learning enables students to learn anytime and anywhere. The teacher provides assistance by setting the observation questions and making effective use of technology to motivate students to learn enthusiastically in an authentic situation. Students develop self-directed learning skills as they are given the opportunity to identify the necessary information and resources to complete the task. They also reflect on their work for further improvement through sharing their findings with their peers and teachers, and reviewing the feedback received.

6D.3.3 *Creating Opportunities for Deeper Learning*

- There is a growing emphasis on a deeper learning approach that engages students in critical thinking, problem solving, collaboration and self-directed learning. The technologies leveraged to support deeper learning pedagogies are continually evolving and can boost the quality, breadth and depth of student work and collaborative projects. For example, with the adoption of a social media platform, students discover new information and publish thoughts and ideas in their own time and space. The same platform also allows students to explore local and global issues and exchange perspectives. This deepens students' thinking and encourages them to experiment with various technologies, platforms and tools according to their needs.

Example 4: Deeper Learning in the Science Education KLA

- Scientific experiments such as exploring the changes in acidity of a substance over time can be tedious and time-consuming as it involves the ongoing collection of data.
- A teacher uses a data-logger to collect and record the data about the change of acidity in water, and helps students understand how pollution affects our everyday life.
- The teacher also introduces a social media platform for students to publish their findings, and exchange views with others about ways to reduce water pollution.

Impact on student learning

- The use of a data-logger, which is an electronic device to collect and record the data automatically, allows students to spend more time on higher order thinking processes such as analysis, synthesis and evaluation on the changes in acidity. The use of an online platform facilitates students' interactions with others, demonstration of their achievements and gain deeper learning.

6D.3.4 *Enhancing Understanding of Abstract Concepts*

- The use of multimedia presentations that include sound effects, animations and graphics can help teachers present the lesson content effectively and explain abstract concepts which are difficult to explain in a conventional classroom. It could also help students master the subject knowledge and abstract concepts as well as engage and motivate them in learning.

Example 5: Understanding Abstract Concepts of Mathematics

- A Mathematics teacher makes use of an interactive software to help students explore the geometric properties of three-dimensional shapes such as pyramids, prisms and cylinders.
- The interactive component of the software allows students to explore three-dimensional figures through animations. When students understand how flat sheets of paper can be folded into three-dimensional objects (e.g. a cylinder consists of two circles and a rectangle), they can discover the formulas to calculate surface areas and volumes, and then apply them to solve a series of practical problems.

Impact on student learning

- Students who are less sensitive to spatial relationships usually find it difficult to understand geometric properties presented on paper. They benefit more from the use a virtual 3-dimensional environment in grasping the abstract concepts. The interactive software provides students with opportunities to discover the properties of three-dimensional figure through animations. In the process, they can try as many times as they like until they understand what is happening. This hands-on experience promotes learning through a constructivist approach and enables students to interact with the subject matter in vivid detail and grasp a solid understanding of the related concepts.

- Technologies like Virtual Reality (VR) and Augmented Reality (AR) can be adopted in schools to enhance students' learning experiences. For VR, it's well-positioned as an educational tool generating immersive environments for field trips, with simulation and research activities serving as a prime enabler of student-centred, experiential and collaborative learning. For AR, the layering of information over 3D space produces a new experience of the world, which is sometimes referred to as "blended reality". It provides contextual, in situ learning experiences that foster exploration of real world data in virtual surroundings and simulations.

Example 6: Adopting VR in a Mathematics Class

- A Mathematics teacher asks his students to work in groups and estimate the height of the One International Finance Centre (One ifc) tower in Central.
- Using VR, students wear a head-mounted display to visualise the virtual environment of One ifc. They position themselves at a distance from the building. The actual distance is then projected from an online map. By measuring the angle of elevation and using the projected distance, the height of One ifc is estimated mathematically.

Example 7: Adopting AR in a History Project

- When students are conducting a history project about Cheung Chau, it would be precious to witness and celebrate local traditions such as the Cheung Chau Bun Festival during their field trip to the island. However, not every school could arrange timely visit for their students.
- As such, a school uses an AR app during students' field trip to Cheung Chau so that they could have access to videos relevant to their place of visit throughout the whole trip. For example, when the app scans the location where the Bun Scrambling Competition is conducted, videos of the previous competitions will be triggered and shown to students.

Impact on student learning

- In Examples 6 and 7, VR and AR allow student to step partly outside of their real environment into the virtual realm and provide them with learning experiences which are similar to hand-on experiences. This holds students' attention, stimulates learning and enables them to retain more knowledge for a longer period of time. Students learn how to interact and communicate with others in a new way with the use of technology and develop skills necessary for the digital age.

6D.3.5 Facilitating Self-directed Learning with e-Learning Resources

- Using e-learning resources to enhance interactive and self-directed learning is a global trend in education. A lot of resources and support for e-learning have been provided by different Government departments, the IT industry, non-governmental organisations (NGOs) and schools, and are available online to facilitate students' self-directed learning.
- The EDB has developed a One-Stop Portal for Learning and Teaching Resources (<http://www.hkedcity.net/edbosp/>) to help teachers in their selection and development of learning and teaching resources for various subjects to meet students' needs. Through this online portal, teachers will have quick access to a variety of digital resources, which can help ease their workload in the preparation of teaching resources. The portal also aims at providing teachers with diversified learning activities to enhance learning and teaching effectiveness. The Hong Kong Public Libraries of the Leisure and Cultural Services Department (LCSD) also provides a range of free and diversified e-services and e-learning resources to meet public demands for information and to enhance lifelong learning.
- In order to develop interactive and diversified e-textbooks as an alternative to printed textbooks, the EDB launched the e-Textbook Market Development Scheme (EMADS) in 2012 to facilitate and encourage the participation of potential and aspiring e-textbook developers to develop a diverse range of e-textbooks in line with the local curricula. e-Textbooks that have successfully undergone the field tests and quality assurance mechanism have been

included on the Recommended e-Textbook List. The quality assurance mechanism has also been open up to non-EMADS developers since 2014.

- The Hong Kong Education City Limited (HKEdCity) helps provide local and overseas quality e-learning resources for use by schools. For example, through the eResources Adoption Programme (eREAP), quality e-learning resources from world-wide education solutions suppliers are sourced for use by teachers. Through the EdMall and EdBookShelf, schools have access to a number of e-books for use by students.
- The IT industry is also a major player to provide support in e-learning. Provision of free trial versions of apps for educational use encourages pedagogical innovation in the school sector.
- NGOs which provide support to parents and students also help promote e-learning and in particular proper attitude in the effective and ethical use of information and IT.
- Some schools also develop apps, videos and resource banks for meeting the specific needs of their students, adopting innovative strategies for learning and teaching, and sharing through Creative Commons.
- When adopting e-learning resources, teachers are required to give students proper guidance and monitor their progress in the development of self-directed learning skills. Figure 6D.1 below depicts the paradigm shift in school education from a teacher-centred to student-centred mode through adopting e-learning.

Figure 6D.1 Features of e-Learning



- Adopting e-learning can make learning more effective, efficient and enjoyable as well as cater for students’ different needs and styles. However, e-learning will not replace the traditional mode of learning. They are both complementary to each other and the key to success is how to make good use of electronic media for the design and planning of learning in a suitable environment.

6D.4 Whole-school Curriculum Planning for Using IT to Promote Student Learning

To keep pace with the fast-changing and globalised digital world, and to capitalise on the advantages of IT, schools can formulate strategies to further unleash students' potential and equip them with learning to learn capabilities as lifelong learners.

6D.4.1 School-based IT Plan

A school-based IT plan serves to help the school management and teachers set a clear direction and implementation details to foster the development of students to become self-directed learners. Schools can consider:

- Facilitating students' self-directed learning with IT;
- Developing students to be ethical users of information and IT;
- Encouraging teachers to use IT appropriately for learning and teaching across the school curriculum;
- Strengthening students' computational thinking skills across disciplines;
- Providing opportunities for students to realise their potential;
- Assessing students' performance in context with the adoption of IT; and
- Protecting students in their use of IT.

Facilitating students' self-directed learning with IT

Schools should create an environment conducive for students to use IT to enhance their learning.

Example 8: Promoting the Sharing and Exchange of Views

- ***Campus TV***: Some schools make use of the Campus TV to play videos and TV programmes/news during the morning assembly, recess or lunch time to raise students' awareness of or arouse their interest in the selected issues/topics.
- ***Video Conferencing***: Some schools use video conferencing to organise learning activities with students in other districts in Hong Kong, other cities or countries to promote interactive learning, e.g. inter-school debates, sharing and exchanging views on specific topics.

Example 9: Supporting Interactive Learning

- ***Mobile Computing Devices and Wi-Fi Infrastructure***: Some schools use mobile computing devices and the Wi-Fi infrastructure to facilitate student learning inside and outside the classroom. For example, in a photography project, a Visual Arts teacher encourages students to upload interesting photos taken by them in the neighbourhood to the school intranet for peers' comments and evaluation. Students comment and share their views on the forum, which will in turn facilitate further artwork done in groups with the use of software. This activity exposes students to a greater variety of art works and helps them develop creative photography ideas.

Example 10: Expanding Learning beyond the School Campus

- Teachers are encouraged to upload the learning and teaching materials to the school intranet so that students have access to e-learning resources beyond the school campus for self-directed learning. In the lesson preparation conducted at home before the lesson, students can also decide how much time to spend on the materials received and prepare the questions to ask.

Reflective Questions

- ✧ Under what circumstances is learning and teaching more effective with the use of IT?
- ✧ Is your school adopting the use of (a) campus TV; (b) video conferencing; (c) mobile computing devices; and/or (d) school intranet; as mentioned in Examples 8-10 to help students develop self-directed learning capabilities?
- ✧ What is your school's experience in nurturing students' self-directed learning capabilities with IT?
- ✧ How does your school facilitate the sharing of ideas among students by using IT to enhance their communication and construction of knowledge?

Developing students to be ethical users of information and IT

- The world is fast changing. From time to time, different scholars have different views on the 21st century skills for our students. In the World Economic Forum 2016, 21st century skills are defined across three areas. The area of “Character Qualities”, which includes curiosity, initiative, persistence/grit, adaptability, leadership as well as social and cultural awareness, is addressed as the key to equipping students with the skills to cope with their changing environment. Professor Howard Gardner in his “Five Minds for the Future” also highlights the importance of “Ethical Mind” to address the common good of a community.
- In the ongoing renewal of the school curriculum, due attention has to be given to developing our students to be an ethical person in all aspects, to lead their own life as lifelong learners who can cope with the changes in society, and to bring about positive changes in our community as ethical users of information and IT. The updated “Information Literacy for Hong Kong Students”, which provides suggestions leading to the development of students as ethical information providers for the well-being of our society, should be adopted by every school.

Example 11: Cyber Ethics

- In a secondary school, students are provided with relevant knowledge about cyber ethics and form groups to discuss different cases and scenarios. They are then invited to share information, their observations and views on related issues such as cyber etiquette, plagiarism and Internet friendship.

More information is available at the webpage “Cyber Ethics for Students and Youth”: <https://cesy.edb.hkedcity.net/en>

Encouraging teachers to use IT appropriately for learning and teaching across the school curriculum

- When IT is used for learning and teaching, teachers should ensure that the linkages with specific learning goals, the learning targets and objectives in KLAs and other contexts are clearly set. Collaboration among different KLAs or subjects can provide adequate learning opportunities for students to connect and integrate their learning. In particular, collaboration in the use of IT with other subjects can help enhance students’ problem solving skills, computational thinking, logical reasoning, analytical skills, etc.
- IT could be applied in the KLA and other contexts for processing information. Teachers have to help students become aware of the roles and functions of information providers in society as well as the conditions under which reliable information could be obtained during the process.
- IT should not be used for the sake of using technology only. The pedagogical value of adopting IT inside or outside class should be addressed. Scaffolding is needed to ensure that students use IT properly to address their learning needs and that it should lead to developing their capability as self-directed learners.
- Both students and teachers should be equipped with the capability to search and use relevant IT tools for learning and teaching. IT should be used timely to encourage students’ collaboration after class, deeper thinking and adoption of appropriate learning resources for self-directed learning as well as to facilitate teachers’ provision of feedback and illustration of abstract concepts in class.

Reflective Questions

With the advancement of technology, innovative strategies such as incorporating Virtual Reality (VR) in designing learning tasks and engaging students in the use of media apps to create videos to share their ideas or showcase the learning products are being evolved to help enhance the effectiveness of student learning.

- ✧ How can these new learning and teaching strategies, if adopted, be applied in your schools to improve students' learning efficiency? Are there any critical factors to facilitate classroom interaction and reduce teachers' workload?
- ✧ How can the strategies be adopted to individual subjects according to your school's salient characteristics?
- ✧ What will be the implementation schedule in consideration of your school's strengths and students' learning needs?
- ✧ What support measures and resources are required to ensure smooth implementation of the strategies?
- ✧ How can your school evaluate the effectiveness of the strategies in helping students learn better?

Developing computational thinking across disciplines

- Strengthening students' computational thinking competence is one of the aims of ITE4. The key task of IT for Self-directed Learning can facilitate the development of computational thinking at the KLA level or across disciplines.
- In secondary schools, computational thinking is taught through Technology Education (TE) subjects. In the TE KLA, computational thinking is defined as an approach to solving problems in a way that can be implemented with a computer (*please refer to Section 4.2.10 of the updated TE KLA Curriculum Guide for more information on "Computational Thinking"*).
- Computational thinking can also be developed in various learning contexts (e.g. English classes and STEM projects) when students learn to understand a problem, break it down into a number of simpler problems, look for and generalise patterns, and eventually work out a solution/an algorithm to tackle the problem.

Providing opportunities for students to realise their potential

- Schools can widen students' horizons, enrich their learning experiences and develop their IT talents through providing opportunities for them to participate in different kinds of IT-related competitions such as programming contests, robotic competitions, video competitions and animation production competitions. Schools can also introduce IT-related careers to arouse students' interest and keep them well informed for their life planning.

Assessing students' performance in context with the adoption of IT

- Schools are encouraged to assess students' performance holistically in the contexts of KLAs with due consideration given to students' learning needs and styles.
- The Student Assessment Repository (STAR) is an online assessment platform which can be accessed through the website of the HKEdCity (<http://star.hkedcity.net>). It comprises a number of features to facilitate teachers using assessment information to enhance student learning with the use of technology. Teachers of Chinese, English and Mathematics can make use of the platform to set various parameters to create assessment tasks for individual students or classes according to their needs and learning progress, as well as to receive instant feedback upon submission of completed tasks. The assessment can be used flexibly with other assessment tools at schools to enhance the effectiveness of student learning.

Reflective Questions

- ✧ What is the mechanism of your school to ensure that students' knowledge, skills and attitude are appropriately nurtured through the use of IT?
- ✧ How effective are the learning and teaching strategies adopted in your school in meeting the learning targets and students' needs?
- ✧ How do your teachers provide proper guidance for students to complete their assignments with IT or prepare them for information search on the Internet?
- ✧ How does your school develop students' IT knowledge and skills in authentic situations or through meaningful learning activities?

Protecting students in their use of IT

- Schools need to raise students' awareness of the various issues arising from the use of IT, and in particular the potential dangers and adverse effects of improper use of computer networks on individuals.
- To ensure a safe and healthy use of IT and to protect themselves, students have to raise their awareness of the following:
 - The importance and the need to verify and evaluate the accuracy and reliability of information, and the ethical use of IT;
 - The legal, social and ethical responsibilities related to the use of IT, such as intellectual property rights, copyrights and use of the Internet;
 - Health issues related to the use of computer, including knowledge for eye care (*please refer to the webpage of the Department of Health for more information:*
http://www.studenthealth.gov.hk/english/health/health_ev/health_ev_coe_p.html)
 - Not to get addicted to Internet browsing or online games;
 - Not to get indulged in virtual roles or neglect communication with people in reality;
 - The importance and ways of protecting personal privacy;
 - The need to protect themselves from exposure to indecent, obscene and violent information; and
 - Seek help from teachers or parents when encountering problems such as cyber bullying.

6D.4.2 *Teacher Professional Development*

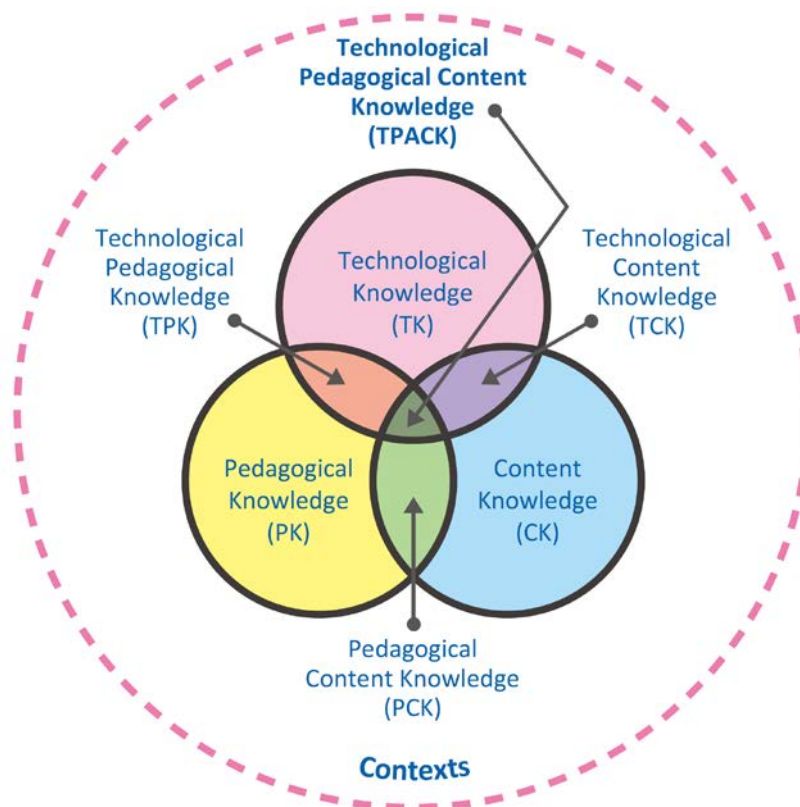
- IT can enhance the effectiveness of learning and teaching in schools. To some teachers, teaching with technology is not an easy task with the complexity of content, pedagogy and ever advancing technology. Teachers have to understand what is critical to effective learning and teaching with technology before they could make the best use of IT.

Technological Pedagogical Content Knowledge (TPACK)

- Technological Pedagogical Content Knowledge (TPACK) is a framework that incorporates the kinds of knowledge required by a teacher to develop effective pedagogical practice in a technology enhanced learning environment. It can be adopted as a language to frame the implementation of IT in schools. More information about TPACK is available at <http://tpack.org>. Figure 6D.2 shows the relationship between the knowledge components in the TPACK framework.

Figure 6D.2 The TPACK Framework and its Knowledge Components

(source: <http://tpack.org>)



Below are two examples depicting how IT enhances student learning. Reflection on teachers' TPACK is also included for reference.

Example 12: Adopting TPACK to Enhance Student Learning in Technology Education KLA

Topic: Ecology and Health

(From the Health Management and Social Care curriculum, a senior secondary elective subject under the Technology Education KLA)

Content Knowledge

Students are required to study and analyse the interrelationships between ecology and health from the ecological perspective. Conceptual interrelatedness and multiple perspectives on the contents are required.

Reflection

 *Learning difficulties*

Examples are used to analyse the interrelationships between ecology and health from the ecological perspective. The contents have been clearly defined to help students organise concepts. However, the interrelationships are still too complex/abstract for students to understand.

 *Improvement to be made*

How could students understand the interrelationships/linkages better?

Pedagogical Content Knowledge

To help students understand the content knowledge of the interrelationships between ecology and health, the teacher arranges group discussions and asks students to draw mind maps to visualise the linkages.

Reflection

Effects on students

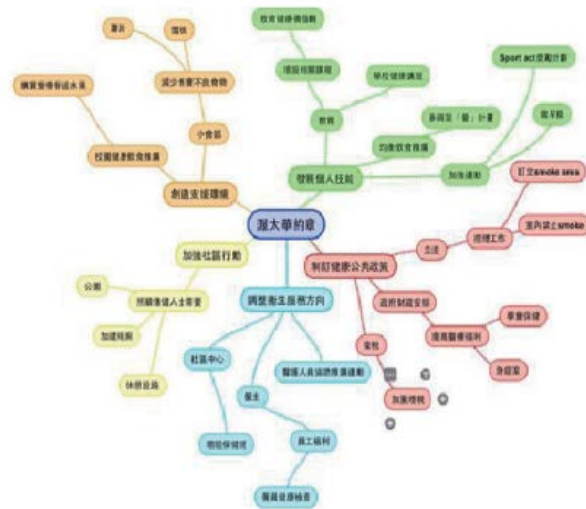
- With the visualised linkages created, students are more engaged during the lessons.
- However, the process is time-consuming, especially when there is a need to revise the interrelationships on the mind map. Students are reluctant to make the changes.

Improvement to be made

How could students revise their work easily to facilitate learning?

Technological Pedagogical Content Knowledge

An IT tool is adopted to enhance the learning effectiveness. Students work in groups, and use the computer and the available software to construct mind maps and revise them after discussions.



Reflection

🌈 *Advantages of using IT*

- Students find it easier to make changes such as re-grouping items upon their discussions.
- Students can easily retrieve their work for revision or further development of concepts.
- IT is a useful tool which facilitates the co-construction of knowledge among students.

🌈 *Challenges ahead*

- In this information era, students can access information from various sources apart from teachers.
- It is important for teachers to take the role as facilitators to help develop students' self-directed learning capabilities.

Example 13: Adopting TPACK to Enhance Student Learning in the Mathematics Education KLA

Topic: Data Handling - Cumulative Frequency Polygon

(From the junior secondary Mathematics curriculum)

Content Knowledge

Students are required to: (i) construct a cumulative frequency polygon for a set of data; and (ii) interpret a cumulative frequency polygon.

Reflection

Learning difficulties

- Constructing a cumulative frequency polygon is quite time-consuming.
- Examples and worksheets are provided to help students understand the concepts. However, some students have difficulty interpreting the cumulative frequency polygon.

Improvement to be made

- It is found that students have not grasped the relationship between the data and the cumulative frequency polygon. How can the teacher help students visualise the relationship?

Technological Pedagogical Content Knowledge

IT is adopted to address the learning difficulties. Students work in pairs/groups to construct a cumulative frequency polygon by using an online spreadsheet software.

Reflection

Advantages of using IT in this topic

- A cumulative frequency polygon can be constructed more easily. Hence, more lesson time can be spent on explaining/clarifying related concepts.
- Students' understanding is enhanced when they can "visualise" how the cumulative frequency polygon changes due to the change of data.
- Students find it easy to draw a new cumulative frequency polygon when the set of data in the frequency table is changed or when another set of data is provided. Teachers may use a similar set of questions to help students consolidate their concepts of a cumulative frequency polygon or increase the level of difficulty to deepen students' understanding.
- By using the online spreadsheet software, it is easy for students to compare the presentations of the same set of data by using various graphs or the same type of graphs but with different scales.

Support to teachers

- The role of teachers has evolved from being transmitters of knowledge to facilitators of learning due to the growing influence of technology in the learning environment. Supports and professional development are important in extending teachers' repertoire in enhancing IT for interactive and self-directed learning. Experience sharing among teachers within and across KLAS/schools is encouraged and should be promoted.
- The EDB will continue to provide a variety of professional development programmes at both the generic and KLA levels to help teachers explore the potential of using IT for the enhancement of learning and teaching effectiveness.

- The EDB will facilitate the setting up of Communities of Practice (CoP) among schools, and organise experience sharing seminars for teachers to enrich their repertoire of e-learning pedagogies and build up their confidence in harnessing IT in education. Teachers are encouraged to form or join CoP within and across schools where they can share their experiences and support each other.
- The EDB will also provide other modes of support for building teacher capacity, including on-site school-based support and district-based PDPs for schools. Teams of professional staff of the EDB will continue to work in partnership with teaching professionals to provide on-site support to schools as requested, aiming at introducing and empowering teachers to adopt or adapt good IT pedagogical and technical practices in their schools, and facilitating effective school cultural changes.
- The EDB has collaborated with the HKEdCity in launching a website Go eLearning (<https://www.hkedcity.net/goelearning>) to introduce the use of the latest technology for learning and teaching. The online resources, including videos demonstrating the use and operation of eLearning tools, corresponding lesson clips and teaching tips, support teachers intending to apply eLearning strategies in their teaching by gathering experiences of teachers who are already using different eLearning tools.

6D.4.3 Other Support Measures

Wi-Fi infrastructure

- The EDB has enhanced Wi-Fi access in all classrooms of public sector schools by phases from the 2015/16 school year. Relevant support measures for schools will be reviewed constantly.

Learning resources

- The EDB will continue to work in partnership with various stakeholders and partners to enrich the supply of quality e-learning resources.

Ongoing researches

- To capture the outcomes and fine-tune the implementation of ITE4, the EDB will conduct ongoing researches, including annual school survey, curriculum implementation survey and case study on the impact of e-learning to examine the changes resulting from the implementation and to identify support measures as appropriate.

Direct support to students

- IT facilities and resources are less accessible for some students than the others. Teachers should make proper arrangements when assigning computer-related learning tasks outside the classroom.

6D.5 Embracing Learner Diversity

- To address students' diverse needs in making effective use of IT for learning, teachers can adopt a variety of learning and teaching strategies. For example, tasks of different levels of difficulty are prepared for the students in Computer lessons so that challenging tasks are available for students to maximise their potential, and learning materials/websites are provided for the less able students to catch up with the necessary IT knowledge and skills. Besides, students with higher levels of IT competence can be assigned as IT leaders to help their fellow classmates. Teacher can also render assistance to encourage and help students participate in IT-related competitions to arouse their interest and widen their horizons.

- The adoption of technology fosters a student-centred environment which helps develop a personalised learning environment to address students' specific learning needs, interests, aspirations and cultural backgrounds. For example, flipped classroom can be adopted as a strategy to help students learn at their own pace, in their own time, and create an appropriate learning environment for the development of self-directed learning.

Reflective Questions

- ✧ How does your school formulate a holistic IT plan to create a conducive learning and teaching environment?
- ✧ Do your students learn better with IT? Under what circumstances do they achieve better learning outcomes?
- ✧ What are the areas for improvement in terms of using IT in the school?

Bibliography

Publications

Balanskat, A., Blamire, R., & Kefala, S. (2006). *The ICT impact report: A review of studies of ICT impact on schools in Europe*. Retrieved from <https://pdfs.semanticscholar.org/6288/63abac8753bcb827f641f596f9e6e2ad5ab7.pdf>

Bruce, B., & B. K. Yasmin. (2001). Ethics and the computer: Children's development of moral reasoning about computer and internet use. *Journal of Educational Computing Research*, 25(2), 111-127.

Clark, R. C., & Mayer, R. E. (2008). *e-Learning and the science of instruction* (2nd ed.). San Francisco, CA: Jossey-Bass/Pfeiffer.

Curriculum Development Council. (2000). *Information technology learning targets: A guideline for schools to organize teaching and learning activities to develop our students' capability in using IT*. Hong Kong: Author.

Curriculum Development Council. (2001). *Learning to learn: The way forward in curriculum development*. Hong Kong: Author.

Doty, D. E., Popplewell, S. R., & Byers, G. O. (2001). Interactive CD-ROM storybooks and young readers' reading comprehension. *Journal of Research on Computing in Education*, 33(4), 374-385. Retrieved from http://ebooksece.wikispaces.com/file/view/Doty,etal_2001_JRCE.pdf

Education and Manpower Bureau. (1998). *Information technology for learning in a new era: Five-year strategy 1998/99 to 2002/03*. Hong Kong: Author.

Fullan, M., & Langworthy, M. (2014). *A rich seam - How new pedagogies find deep learning*. Retrieved from http://www.michaelfullan.ca/wp-content/uploads/2014/01/3897.Rich_Seam_web.pdf

Gardner, H. (2006). *Five minds for the future*. Harvard Business Press.

Higgins, S., & Muijs, R. D. (1999). ICT and numeracy in primary schools. In I. Thompson (Ed.), *Issues in Teaching Numeracy In Primary Schools*. Ballmoor, Bucks: Open University Press.

Hong Kong Institute of Education. (2012). *Report on the review surveys of the third strategy on information technology in education*. Hong Kong: Education Bureau. Retrieved from http://www.edb.gov.hk/attachment/en/edu-system/primary-secondary/applicable-to-primary-secondary/it-in-edu/RS2_Final%20Report_PUBLIC_Eng_clean%2021012013.pdf

Ingram, A. L., Hathorn, L. G., & Evans, A. (2000). Beyond chat on the Internet. *Computers and Education*, 35(1), 21-35.

John van Braak, J. (2001). Individual characteristics influencing teachers' class use of computers. *Journal of Educational Computing Research*, 25(2), 141-157.

Ki, W. W. (2000). ICT Applications in task-based learning. In N. Law, H. K. Yuen, W. W. Ki, S. C. Li, Y. Lee, & Y. Chow (Eds.), *Changing classroom and changing schools: Study of good practices in using ICT in Hong Kong schools* (pp.79-91). Hong Kong: Centre for Information Technology in School and Teacher Education, The University of Hong Kong.

Koehler, Matthew J., Technological Pedagogical Content Knowledge (TPACK), <http://www.tpack.org>

Li, S. C. (2000). Using ICT in Inductive Teaching and Learning. In N. Law, H. K. Yuen, W. W. Ki, S. C. Li, Y. Lee, & Y. Chow (Eds.), *Changing classroom and changing schools: Study of good practices in using ICT in Hong Kong schools* (pp. 69-78). Hong Kong: Centre for Information Technology in School and Teacher Education, The University of Hong Kong.

Li, S. C., Lee, F. L., Kong, S. C., & Henri, J. (2005). *Information literacy framework for Hong Kong: Building the capacity of learning to learn in the information age*. Hong Kong: Education and Manpower Bureau. Retrieved from http://www.edb.gov.hk/attachment/en/edu-system/primary-secondary/applicable-to-primary-secondary/it-in-edu/il_eng_7323.pdf

Luckin, R. (2001). *Designing children's software to ensure productive interactivity through collaboration in the zone of proximal development (ZPD). Information technology in childhood education annual 2001*. Charlottesville, VA: Association for the Advancement of Computing in Education.

Moursund, D. G. (1999). *Project-based learning using information technology: ITSE approaches*. Amsterdam: Pergamon.

Pelgrum, W. J. (2001). Obstacles to the integration of ICT in education: Results from a worldwide educational assessment. *Computers and Education*, 37, 163-178.

Smita, G. (2001). Integrating computers in elementary grade classroom instruction - Analysis of teachers' perceptions in present and preferred situations. *Journal of Educational Computing Research*, 24(3), 275-303.

Working Group on Textbooks and e-Learning Resources Development. (2009). *Working group on textbooks and e-learning resources development- Report*. Hong Kong: Education Bureau. Retrieved from <http://www.edb.gov.hk/attachment/en/edu-system/primary-secondary/applicable-to-primary-secondary/it-in-edu/wg%20final%20report.pdf>

World Economic Forum. (2016). *New vision for education: Fostering social and emotional learning through technology*. World Economic Forum, Geneva, Switzerland.

Yuen, H. K., & Chow, Y. (2000). Social constructivist approach. In N. Law, H. K. Yuen, W. W. Ki, S. C. Li, Y. Lee, & Y. Chow (Eds.), *Changing classroom and changing schools: Study of good practices in using ICT in Hong Kong schools* (pp.103-113). Hong Kong: Centre for Information Technology in School and Teacher Education, The University of Hong Kong.

Yuen, H. K., & Y. Lee (2000). Problem-based learning using ICT. In N. Law, H. K. Yuen, W. W. Ki, S. C. Li, Y. Lee, & Y. Chow (Eds.), *Changing classroom and changing schools: Study of good practices in using ICT in Hong Kong schools* (pp. 93-102). Hong Kong: Centre for Information Technology in School and Teacher Education, The University of Hong Kong.

Websites

Cyber Ethics for Students and Youth (Hong Kong Education City)

https://resources.hkedcity.net/resource_detail.php?rid=301334579

Go eLearning (Hong Kong Education City)

https://www.hkedcity.net/goelearning/en/static/about_go_elearning

Health effects on use of the Internet and electronic screen products (Department of Health)

http://www.studenthealth.gov.hk/english/internet/health_effects.html

IT in Education (EDB)

<http://www.edb.gov.hk/ited>

One-stop Portal for Learning & Teaching Resource (EDB)

<http://www.hkedcity.net/edbosp>

