Technology Education
Key Learning Area

Design and Applied Technology
Curriculum and Assessment Guide
(Secondary 4 - 6)

Jointly prepared by the Curriculum Development Council and
the Hong Kong Examinations and Assessment Authority

Recommended for use in schools by the Education Bureau
HKSARG
2007 (with updates in November 2015)

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Preamble

The Education and Manpower Bureau (EMB, now renamed Education Bureau (EDB)) stated in its report[1] in 2005 that the implementation of a three-year senior secondary academic structure would commence at secondary 4 in September 2009. The senior secondary academic structure is supported by a flexible, coherent and diversified senior secondary curriculum aimed at catering for students' varied interests, needs and abilities. This Curriculum and Assessment (C&A) Guide is one of the series of documents prepared for the senior secondary curriculum. It is based on the goals of senior secondary education and on other official documents related to the curriculum and assessment reform since 2000. To gain a full understanding of the connection between education at the senior secondary level and other key stages, and how effective learning, teaching and assessment can be achieved, it is strongly recommended that reference should be made to all related documents.

This C&A Guide was designed to provide the rationale and aims of the subject curriculum, followed by chapters on the curriculum framework, curriculum planning, pedagogy, assessment and use of learning and teaching resources. One key concept underlying the senior secondary curriculum is that curriculum, pedagogy and assessment should be well aligned. While learning and teaching strategies form an integral part of the curriculum and are conducive to promoting learning to learn and whole-person development, assessment should also be recognised not only as a means to gauge performance but also to improve learning. To understand the interplay between these three key components, all chapters in the C&A Guide should be read in a holistic manner.

The C&A Guide is jointly prepared by the Curriculum Development Council (CDC) and the Hong Kong Examinations and Assessment Authority (HKEAA) in 2007. The first updating was made in January 2014 to align with the short-term recommendations made on the senior secondary curriculum and assessment resulting from the New Academic Structure (NAS) review so that students and teachers could benefit at the earliest possible instance. This updating is made to align with the medium-term recommendations of the NAS review made on curriculum and assessment. The CDC is an advisory body that gives recommendations to the HKSAR Government on all matters relating to curriculum development for the school system from kindergarten to senior secondary level. Its membership includes heads of schools, practising teachers, parents, employers, academics from tertiary institutions, professionals from related fields/bodies, representatives from the HKEAA and the Vocational

[1] The report is *The New Academic Structure for Senior Secondary Education and Higher Education – Action Plan for Investing in the Future of Hong Kong*.

Training Council (VTC), as well as officers from the Education Bureau. The HKEAA is an independent statutory body responsible for the conduct of public assessment, including the assessment for the Hong Kong Diploma of Secondary Education (HKDSE). Its governing council includes members drawn from the school sector, tertiary institutions and government bodies, as well as professionals and members of the business community.

The C&A Guide is recommended by the Education Bureau for use in secondary schools. The subject curriculum forms the basis of the assessment designed and administered by the HKEAA. In this connection, the HKEAA will issue a handbook to provide information on the rules and regulations of the HKDSE Examination as well as the structure and format of public assessment for each subject.

The CDC and HKEAA will keep the subject curriculum under constant review and evaluation in the light of classroom experiences, students' performance in the public assessment, and the changing needs of students and society. All comments and suggestions on this C&A Guide may be sent to:

Chief Curriculum Development Officer (Technology Education)
Curriculum Development Institute
Education Bureau
Room W101, 1/F, West Block
Education Bureau Kowloon Tong Education Services Centre
19 Suffolk Road
Kowloon Tong, Hong Kong

Fax: 2768 8664
E-mail: teched@edb.gov.hk

Acronym

ApL	Applied Learning
C&A	Curriculum and Assessment
CDC	Curriculum Development Council
EDB	Education Bureau
EMB	Education and Manpower Bureau
HKDSE	Hong Kong Diploma of Secondary Education
HKEAA	Hong Kong Examinations and Assessment Authority
IT	Information Technology
KLA	Key Learning Area
SS	Senior Secondary
OLE	Other Learning Experiences
S1/2/3/4/5/6/7	Secondary 1/2/3/4/5/6/7
SBA	School-based Assessment
SLP	Student Learning Profile
SRR	Standards-referenced Reporting
VTC	Vocational Training Council

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Chapter 1 Introduction

This chapter provides the background, rationale and aims of Design and Applied Technology (DAT) as an elective subject in the three-year senior secondary curriculum, and highlights how it articulates with the junior secondary curriculum, post-secondary education, and future career pathways.

1.1 Background

Technology Education (TE) in the Hong Kong school curriculum focuses on how human beings solve their daily problems and how the processes involved can be replicated and transferred to solve new problems. It is an essential area of study for all students in Hong Kong.

In the 21st century, technology has become an integral part of our life. Citizens of today require much more than a basic ability to read, write, and do simple mathematics. To live in the modern world, we must understand how technology affects us. In this regard, we must be equipped to use technology effectively and flexibly to solve daily problems with positive attitude at home, in the community, and around the world; and to create new solutions, products, and services for the well-being of humankind.

By studying the related subjects developed in TE Key Learning Area (KLA), our students will be better prepared to meet the uncertainties and challenges of the future with regard to social, economic, ecological, scientific and technological changes, both locally and globally. Their studies in this area will help them to lead a healthy lifestyle in adulthood and to contribute to building a caring and harmonious society.

Building on the strengths of the existing TE curriculum and catering for social, economic and technological development, DAT is one of the five elective subjects developed under Technology Education Key Learning Area in the senior secondary curriculum.

The *Senior Secondary DAT Curriculum and Assessment Guide* incorporates the key recommendations in the Curriculum Development Council's *Senior Secondary Curriculum Guide* (2009) and the *Technology Education Key Learning Area Curriculum Guide (Primary 1–Secondary 3)* (2002), as well as the final report on its Holistic Review of the School Curriculum: *Learning to Learn – The Way Forward in Curriculum Development* (2001). These three documents outline the overall direction for both education and curriculum development in Hong Kong, and seek to promote lifelong learning and whole-person development.

1.2 Rationale

Hong Kong has many advantages as an international city. It is a very safe society, with judicial independence, equal opportunities, and a prime location. However, as globalisation develops and inter-regional as well as inter-city competition intensifies, we cannot afford to be content with our existing advantages. In addition to pursuing our core industries, (financial services, producer services, logistics and tourism), we must create new opportunities for development, using new and advanced technologies in various products and creative industries (e.g. film production, publishing, architecture, advertising, various types of design, and digital entertainment).

Design is the soul of a product. A product can be an artifact, a system, an environment, or a service that satisfies people's needs and wants. A good design can reinvent a business and significantly enhance the competitiveness of products and services. In DAT, students will be given the opportunity to tackle problems in various technological areas. It is anticipated that through developing a range of ideas and constructing product and system prototypes, students will become autonomous and creative problem-solvers.

In solving a design and technological problem, students need to develop and employ knowledge from a range of technological areas such as electronics, material processing and computer-aided design (CAD). DAT calls for the understanding and application of knowledge in a range of technological areas to address particular needs and aspirations. It encourages students to explore the synthesis of ideas and practices and examine the effect of technology on societies and environments. Apart from equipping students with knowledge and skills in technology and design, DAT also aims to develop students' capability for self-directed and lifelong learning, so as to prepare them for further studies and adult life. In the long run, DAT will help to attract more talent into design-related and high-technology fields and build Hong Kong into a centre for design and creative industries.

In DAT, students learn to suggest alternatives, tackle unexpected results and manage failures. During the learning process, students are expected to reflect on their learning, solicit feedback from their teachers and peers, illustrate and present their learning outcomes, and document the learning process. This learning in DAT will enable students to develop positive values and attitudes such as perseverance, resilience and risk-taking.

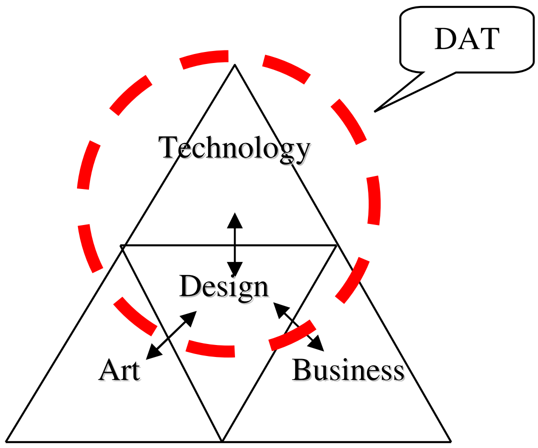
The essence of DAT in schools lies in enabling students to engage in the creative human process of bringing about positive change. To this end, 'innovation' and 'entrepreneurship' are the two core concepts to be developed through the study of DAT.

In the context of DAT, 'innovation' means developing creative ideas towards tangible solutions. The logical design process in technology enables students to gain experience in developing, evaluating, and refining ideas to tackle design and technological problems. 'Entrepreneurship' means searching for client-oriented and value-driven design, and developing enterprising attitudes such as initiative, risk-taking, responsibility, and adaptability. Technology has consequences, costs, and benefits that need to be considered carefully and responsibly before decisions are made. DAT enables students to seek and realise opportunities in a business-like way.

As the language of technology comprises concrete visual images, symbols, and models, the study of DAT will encourage students to think and communicate in terms of forms and structures. In addition, the interactive use of hands and mind in various learning activities helps to develop both their mental abilities and physical skills.

The ideas in technology and design are complex and have diverse applications. The knowledge bases involved in DAT are both rich and extensive and can lead to a range of professions. In the DAT curriculum, 'design' refers to purposeful action to address particular needs and wishes, whereas 'technology' is the purposeful application of knowledge, skills, experience and resources to provide feasible solutions to problems in daily life. The study of DAT is concerned mainly with technological areas but its learning activities inevitably touch on aesthetic and enterprise perspectives. The relationship of DAT to design, technology, art and business is depicted in Figure 1.1.

Figure 1.1 *Relationship of DAT to design, technology, art and business*



1.3 Curriculum Aims

The overarching aim of the DAT curriculum is to provide students with fundamental knowledge and skills in technology and design, and to cultivate them the attributes of innovation and entrepreneurship necessary to face the rapid social, economic and technological changes in a knowledge-based economy.

The broad aims of the curriculum are to enable students to:

(a) become independent thinkers and innovative problem-solvers;

(b) develop practical skills and knowledge in technology and design;

(c) identify needs, wants and opportunities for improving the quality of living, and develop design and technological responses as well as entrepreneurship, accordingly; and

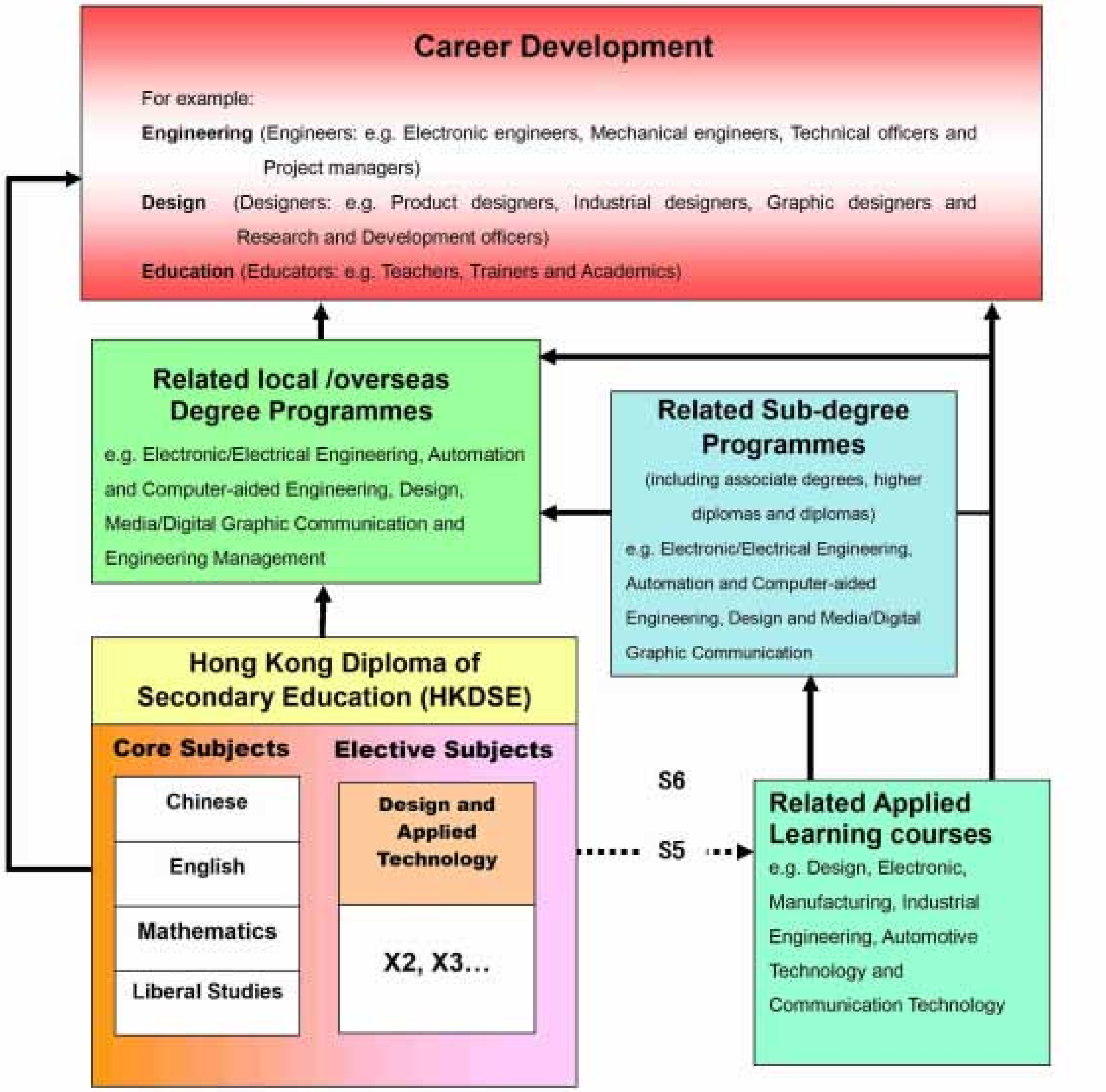
(d) become discriminating, informed and responsible users of products, and develop their awareness of the interplay between technology and aesthetic, enterprise, social, cultural and ethical issues.

1.4 Interface with the Junior Secondary Curriculum and Post-secondary Pathways

Students will have acquired prior knowledge helpful for studying DAT through their TE learning at the junior secondary level as set out in the *TE KLA Curriculum Guide (P1–S3)*. DAT involves an extended study of knowledge contexts such as 'Design and Applications', 'Materials and Structure', 'Operations and Manufacturing' and 'Systems and Control', as outlined in the Curriculum Guide.

Students who intend to study areas such as design, engineering, applied science and media communication at the tertiary level will find DAT helpful in making informed decisions about their future studies, as depicted in Figure 1.2.

Figure 1.2 *Pathways for studying DAT*



Students' interests developed through the study of DAT may help to develop career aspirations in the areas mentioned above.

1.5 Cross-curricular Links

There are cross-curricular elements in the curriculum to strengthen connections and bring about coherence. Students may study DAT with other TE elective subjects such as ‘Business, Accounting and Financial Studies’ to become business-oriented; and ‘Information and Communication Technology’ to become more technology-oriented.

The knowledge, experience and skills developed in DAT can complement those developed in other KLAs and contribute significantly to students’ development, e.g.

- DAT with Liberal Studies and Chinese Language can enrich students’ cultural and social understanding in tackling design problems.
- DAT with Physics can enhance their knowledge in applied science.
- DAT with Visual Arts can develop their aesthetic sense in design.
- DAT with Geography can develop their spatial and graphical perspectives, and awareness of environmental and urban planning concerns.

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Chapter 2 Curriculum Framework

The curriculum framework for DAT embodies the key knowledge, skills, values and attitudes that students are to develop at senior secondary level. It forms the basis on which schools and teachers plan their school-based curriculum and design appropriate learning, teaching and assessment activities.

2.1 Design Principles

The design of the DAT curriculum is founded on the following principles:

- **Effective progression**

  To enable progression from the junior secondary to the senior secondary curriculum, DAT is developed upon the prior knowledge, skills, values and attitudes that students acquire through their learning experiences in basic education. The study of DAT prepares students to pursue further academic and vocational/professional education and training and to articulate to post-secondary and university education programmes, or to enter the workplace.

- **Balance between breadth and depth**

  In DAT, the compulsory part serves as a foundation for students to gain a broad picture of technology and design. In the elective part, students carry out an in-depth study of specific technological areas by choosing from a range of optional modules.

- **Balance between theoretical and applied learning**

  DAT embodies a balance between theoretical and applied learning. Students have opportunities to apply the knowledge they have acquired to solve practical and technical problems.

- **Balance between essential learning and a flexible and diversified curriculum**

  The compulsory part of DAT provides students with essential knowledge and concepts of technology and design, and prepares them for further studies in the area. Students can explore their interests and aspirations during the study of the compulsory part in S4 and progress to S5 and S6 in their chosen studies, or they may take the elective part of DAT or a related study in an Applied Learning (ApL) course.

- **Enquiry-based learning**

  DAT emphasises learning through case study and design projects, which encourage students to build up a solid knowledge base and develop higher-order thinking skills, problem-solving skills and other generic skills to meet future challenges.

2.2 Learning Targets

The learning targets of the various components in the DAT curriculum framework are set out in Figure 2.1:

Figure 2.1 *Learning targets in the DAT curriculum*

Components	Learning Targets
Compulsory part: Technology, Design and Society	Students should ***understand*** and ***discuss***: • How to generate technology and design ideas • How to communicate technology and design ideas • How to appraise technology and design • How things work
Elective part: Technological Studies	Students should ***apply***: • The principles of specific technology to solve problems Students should ***manage***: • The operation of specific technology in design and realisation Students should ***appraise***: • The nature of specific technology and the effects of its processes
Coursework	Students ***design, realise, appraise,*** and ***evaluate*** products to address design needs in a range of technological areas.

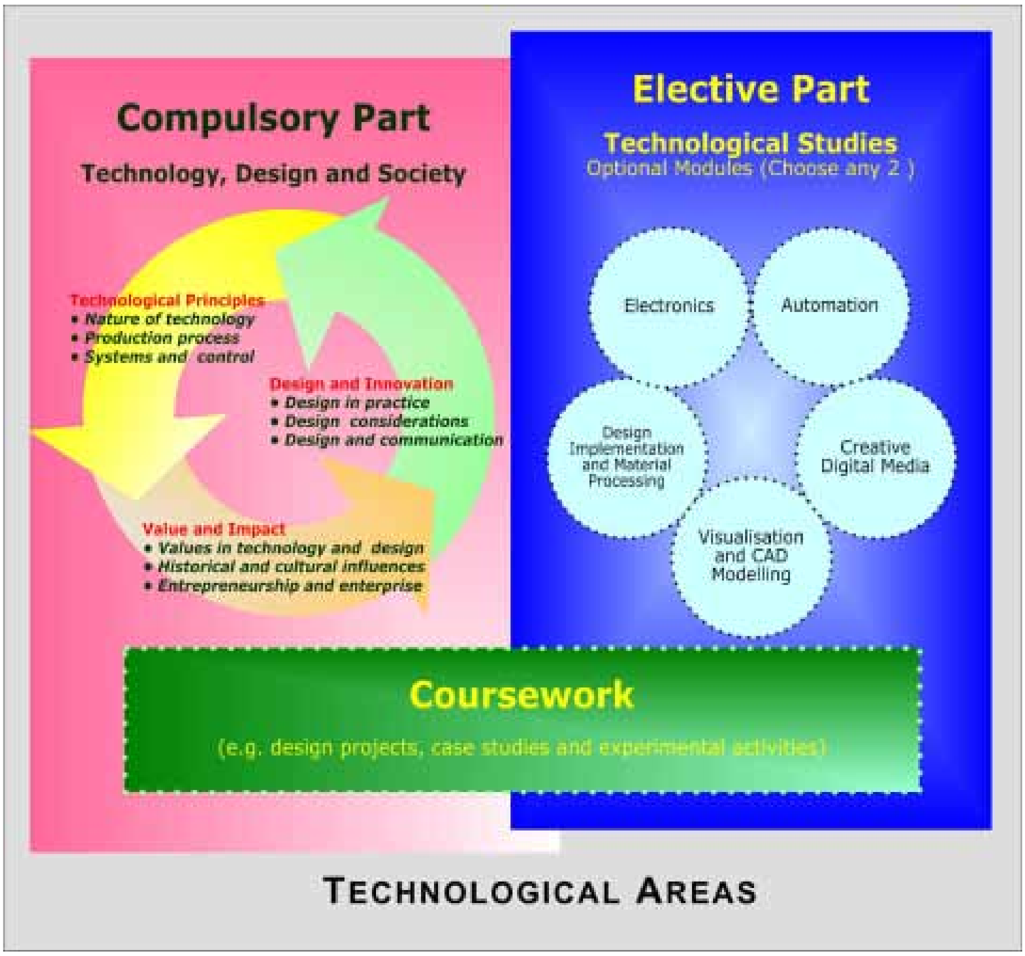
2.3 Curriculum Structure and Organisation

2.3.1 Curriculum structure

The DAT curriculum comprises compulsory and elective parts. Students are required to study the compulsory part plus two optional modules in the elective part. Within the compulsory and elective parts, students have to carry out coursework as an integral part of their studies.

The organisation of the DAT curriculum is depicted in Figure 2.2:

Figure 2.2 *Organisation of DAT curriculum*



2.3.2 Time allocation

The total lesson time allocated to DAT is 250[2] hours, which includes about 80 hours for coursework. A rough estimation of the time allocation is:

- Compulsory part (about 50%)
- Elective part (about 50% for two optional modules of around 25% each)

2.3.3 Curriculum organisation

A table of content for each component in the compulsory and elective parts, which is made up of three columns (i.e. topics, outcomes and explanatory notes), is used to illustrate clearly the kind of learning to be achieved.

(a) Topics – This column lists the key learning elements.

(b) Outcomes – This column lists the expected learning outcomes which help to clarify the scope and depth of study.

(c) Explanatory notes – This column suggests examples or activities for learning and teaching that help students to build up the required knowledge, skills and attitudes; or provide further elaboration of the expected learning outcomes. Those listed are not exhaustive, and teachers are encouraged to develop other learning activities as appropriate.

[2] The lesson time for Liberal Studies and each elective subject is 250 hours (or 10% of the total allocation time) for planning purpose, and schools have the flexibility to allocate lesson time at their discretion in order to enhance learning and teaching effectiveness and cater for students' needs.

"250 hours" is the planning parameter for each elective subject to meet local curriculum needs as well as requirements of international benchmarking. In view of the need to cater for schools with students of various abilities and interests, particularly the lower achievers, "270 hours" was recommended to facilitate schools' planning at the initial stage and to provide more time for teachers to attempt various teaching methods for the SS curriculum. Based on the calculation of each elective subject taking up 10% of the total allocation time, 2,500 hours is the basis for planning the 3-year senior secondary curriculum. This concurs with the reality check and feedback collected from schools in the short-term review, and a flexible range of 2400±200 hours is recommended to further cater for school and learner diversity.

As always, the amount of time spent in learning and teaching is governed by a variety of factors, including whole-school curriculum planning, learners' abilities and needs, students' prior knowledge, teaching and assessment strategies, teaching styles and the number of subjects offered. Schools should exercise professional judgement and flexibility over time allocation to achieve specific curriculum aims and objectives as well as to suit students' specific needs and the school context.

2.4 Learning Objectives

2.4.1 Compulsory part: Technology, Design and Society

The compulsory part provides students with a macro view of technology and design. It serves as a platform for the in-depth exploration of a range of technological areas in the elective part.

In the compulsory part, students are expected to develop the following :

(a) creative, analytical and critical thinking abilities;

(b) design, modelling and communication skills;

(c) understanding of design practices and technological principles in a variety of broad inter-related design contexts; and

(d) technological, social and entrepreneurship awareness.

Students should be encouraged to find connections between technology, design and society through the learning activities they engage in. A variety of design contexts can be explored such as personal life, the home, the school, recreation, the community, the environment, business and industry. Coursework – such as case studies, research and development, product analysis, design projects and enterprise activities – as well as experiences in the wider world are used to enable students to link theory with practice.

The knowledge and concepts in the compulsory part are grouped into three interwoven strands, namely ‘design and innovation’, ‘technological principles’, and ‘value and impact’.

The compulsory part includes the following learning elements:

COMPULSORY PART
Technology, Design and Society

STRAND 1 DESIGN AND INNOVATION

1. Design in Practice

- Design Fundamentals
- Design Process
- Creativity in Design
- Project Management and Teamwork
- Roles of Designers and Engineers

2. Design Considerations

- Design Brief and Specifications
- Solving design problems
- Human and Environmental Factors
- Product Standards
- Design Evaluation

3. Design and Communication

- Project Presentation and Report
- Visual Representation
- Physical, Graphical, Mathematical and Computer Modelling

STRAND 2 TECHNOLOGICAL PRINCIPLES

1. Nature of Technology

- Innovation and Technology
- Energy and Energy Resources
- Materials and Standard Components

2. Production Process

- Health and Industrial Safety
- Tools, Equipment and Machineries
- Manufacturing Systems

3. Systems and Control

- Input-Process-Output
- Logic Gates
- Mechanical Systems
- Physical Structure
- Basic Electronics

STRAND 3 VALUE AND IMPACT

1. Values in Technology and Design

- The Changing Roles of the Designers and Engineers in Society
- Intellectual Property
- Product Evaluation
- Environmental Responsibility
- Appropriate Technology

2. Historical and Cultural Influences

- Evolution of Craft and Design
- Design and Culture
- New Technology

3. Entrepreneurship and Enterprise

- Competitive Edge of Hong Kong
- Design to Meet Market Aspirations
- Design Strategies

***Strand 1* Design and Innovation**

This strand focuses on the generation of design ideas. It aims at helping students to develop an understanding of design principles for product development and to communicate ideas.

Topics *Students should learn*	Outcomes *Students should be able to*	Explanatory notes
Design in practice • Design fundamentals • Design process • Creativity in design • Project management and teamwork • Roles of designers and engineers	1. Interpret design elements and the beauty of objects 2. Utilise design tools, materials, and information 3. Explain ideas and stages of design development 4. Apply creative thinking techniques to generate new ideas 5. Identify the needs of users and customers 6. Collect product information 7. Make a critical assessment of design and production activities 8. Perform cost benefit assessment in product development 9. Understand the roles of designers and engineers at work	• Understand design fundamentals (e.g. lines, 2D graphics, 3-D forms, space, colour, composition, organisational principles, and psychological effects on human beings) • Strike a balance between the functional and aesthetic aspects of artifacts (e.g. craft objects and mass produced products) • Understand the aesthetic and functional qualities in design by exploring the use of surface material (e.g. visual, physical, and tactile qualities) • Use drawing tools, modelling materials, standard parts and components, information technology (IT), and other resources (e.g. museums, galleries, and exhibitions) • Describe the development processes of design (e.g. continuous or spiral cycle) in various activities (e.g. scientific inventions, technological development from ideas to viable products, production, marketing and sales, and product differentiation) • Use various design methods (e.g. creative and rational methods, the morphological chart method) and design thinking techniques (e.g. lateral and vertical thinking, constructive discontent, adaptation, analogy, brainstorming, insight relying on deep understanding, and concept development) • Select and use appropriate research methods (e.g. literature search, experiment, expert appraisal, performance test) to collect, interpret and report design information • Consider competing products, design options and alternatives • Appreciate the implications of changes in design • Formulate management plans (e.g. costing, time management, task analysis and work flow, team assignments and activity plans, quality check and control, and logging and reporting) to meet the identified goals • Explain design practices relating to management, production teams, marketing and business, etc in the Hong Kong and Pearl River Delta industries (e.g. case studies and on-site visits)

Topics *Students should learn*	Outcomes *Students should be able to*	Explanatory notes
Design considerations • Design brief and specifications • Solving design problems • Human and environmental factors • Product standards • Design evaluation	10. Specify design requirements 11. Adopt a holistic design approach to solve problems 12. Take human and environmental factors into consideration in the design process 13. Appreciate the international standards of materials and products 14. Evaluate designs according to design briefs, criteria and specifications	• Formulate design brief and specifications from a needs analysis (e.g. purpose, function, aesthetics, performance, market, characteristics, taste and style, and safety) and set the design criteria • Describe different ways to solve problems in various technological areas and design contexts (e.g. contemporary architecture, advertisements, domestic products, toys, and control systems), and appreciate the designer's intent and how a design is perceived • Consider the suitability of designs (e.g. ergonomics and anthropometrics, and physical and psychological factors) • Integrate and apply knowledge of environmental factors (e.g. spatial arrangement, lighting, ventilation, access) and other relevant disciplines to create built environments that are functional, innovative, sustainable, appropriate, and attractive • Appreciate industrial standards (e.g. GB and ISO)* and assess their effects on product design, manufacturing and testing • Explain how legislation (or government/ trade/ industrial organisations) affects the nature of product and consumer rights. • Modify proposed solutions to problems in the light of new findings or considerations
Design and communication • Project presentation and report • Visual representation • Physical, graphical, mathematical, and computer modelling	15. Present design concept with clarity 16. Select and use appropriate communication techniques 17. Conduct presentations in 2D, 3D and multi-media	• Make a presentation to potential clients (e.g. manufacturer or purchaser) or in product promotion • Express design ideas through visual communication (e.g. portfolio, simple model, mind map, graphic tools and techniques) • Use freehand drawings, orthographic drawings, isometric drawings, models, computer-aided design (CAD) drawings, algorithm equations, flow charts or tables, and animations to describe and illustrate design solutions

* Note:
GB - Guo Biao (National Standards of The People's Republic of China)
ISO - International Organisation for Standardisation

<u>Strand 2</u> Technological Principles

This strand focuses on the fundamentals of technological knowledge and principles. Through investigations into technological practices, students gain knowledge of the resources and processes for solving practical and technical problems.

Topics *Students should learn*	Outcomes *Students should be able to*	Explanatory notes
Nature of technology • Innovation and technology • Energy and energy resources • Materials and standard components	18. Understand the nature of technology 19. Understand the systems of energy sources and natural resources 20. Understand energy consumption in the operation of products and its impact on design 21. Understand the properties of commonly used materials	• Describe broad perspectives of invention and innovation (e.g. Octopus system) • Explain the difference between innovation and invention, and science and technology • Case study of engineering products: Analyse a bicycle and its systems (e.g. energy conversion, transmission and control systems), materials used, and manufacturing processes • Consider the use of energy in operation of products (e.g. sources of energy, including renewable energy, efficiency, conversion, power and energy, consumption, waste and conservation) • Explore and describe material properties (e.g. the structure of matter, bonding, and stress and strain) of plastics/ wood/ metal/ ceramic • Discuss issues related to maximising the use of materials • Design and make products using appropriate materials and standard components (e.g. bolt and nut) • Account for material use in beverage containers (e.g. raw material, process, market form, recycling, optimising resource exploitation, and government policy)
Production process • Health and industrial safety • Tools, equipment and machineries • Manufacturing systems	22. Consider safety precautions in the workplace 23. Select and use appropriate tools and equipment 24. Execute appropriate fabrication processes 25. Understand different manufacturing systems	• Account for safety measures (e.g. workshop safety, rules and regulations, and codes of practice) to safeguard people from injury • Apply appropriate tools in the shaping (e.g. filing and forging), joining (e.g. riveting and screwing), machining (e.g. drilling, turning, laser cutting and vacuum forming) and finishing (e.g. coating and painting) of materials • Explain various manufacturing systems (e.g. one-off, batch, and mass production)

Topics *Students should learn*	Outcomes *Students should be able to*	Explanatory notes
Systems and control • Input-Process-Output • Logic gates • Mechanical systems • Physical structure • Basic electronics	26. Understand various forms of system and control 27. Illustrate control systems with block diagrams 28. Interpret truth tables for simple logic gates 29. Apply knowledge/ concepts of mechanics in design, fabrication and control of systems 30. Understand the nature of forces and stability of structures 31. Understand the basic principles of electronic systems	• Explain the input, process and output of appliances (e.g. hair dryer and washing machine) • Identify the sub-systems in a mass transit system (e.g. mechanical, electronic, and pneumatic systems in the Mass Transit Railway) • Appreciate the working principles of simple logic gates (e.g. OR, AND and NOT) • Propose suitable types of control, transmission systems and motion conversion (e.g. linkage, cam and follower, slider crank, rack and pinion, and ratchet and pawl) in designing a mechanical toy • Suggest shapes and forms of products with due consideration of structural strength and stability • Appreciate simple electronic control and interfaces using electronic learning kits

Strand 3 ***Value and Impact***

This strand focuses on developing an awareness of technology development and of its impact on society. Students are encouraged to recognise the value and contribution of technology to society, its historical and cultural influences, and the link between technology and enterprise.

Topics *Students should learn*	Outcomes *Students should be able to*	Explanatory notes
Values in technology and design • The changing roles of the designers and engineers in society • Intellectual property • Product evaluation • Environmental responsibility • Appropriate technology	32. Identify the impact and value of design 33. Understand the value of intellectual property 34. Analyse and evaluate manufactured products 35. Consider the environmental issues related to design, production and the sale of products 36. Understand the needs of resource conservation	• Evaluate a design solution, with critical insights into relevant issues (e.g. aesthetic, social, economic, technical, legal and ethical issues) • Consider the social responsibilities (e.g. user-centred design, health and safety, professional ethics, and disposal of products) of designers (e.g. from individual, corporate, and collective perspectives) • Understand the principles of legal protection of design (e.g. intellectual property rights, copyright, patents, and trademarks) • Make critical comments on manufactured products (e.g. appropriate technology and resources, balancing criteria, and exercising value judgment) • Make informed decisions on purchasing manufactured products • Consider sustainable development (e.g. environmental issues, clean technology, and green design) in designing and appraising products (e.g. a motion-powered light torch)
Historical and cultural influences • Evolution of craft and design • Design and culture • New technology	37. Understand the development of craft and production technology 38. Understand the impact of design on culture 39. Understand the impact of new technologies on the quality of life	• Discuss the historical influence of design (e.g. the origin and purpose of design activities, design movements, and a technology timeline) • Explain the relevance and influence of design in different cultures and societies (e.g. local, Chinese, and Eastern and Western) • Analyse the impact of emerging technologies (e.g. green design, environment-friendly processes, miniaturisation, advanced production techniques, and smart materials)

Topics *Students should learn*	Outcomes *Students should be able to*	Explanatory notes
Entrepreneurship and enterprise • Competitive edge of Hong Kong • Design to meet market aspirations • Design strategies	40. Understand Hong Kong's small and medium-sized enterprises and their competitiveness 41. Understand the essentials of corporate strategy and business strategy in design 42. Propose business and marketing plans 43. Manage a product design project 44. Demonstrate commitment in fulfilling the wants of consumers and providing value-added products	• Research successful cases of commercially viable products, explaining how user needs are addressed (e.g. trends, cost and quality, appeal of the product, and product redesigned for market changes) • Case studies such as design strategies in different modes of manufacturing, outsourcing design consultants, and in-house design teams • Discuss the influence of entrepreneurial activity (e.g. brand building, continuous improvement of quality, and customer satisfaction) on design success (e.g. 'design-leader' strategy, 'quick-follower' strategy, and 'me-too' strategy) • Identify design gaps and options (e.g. new or redesigned products/services; SWOT (Strength/Weakness/Opportunity/Threat) analysis; demand-pull factors such as function, aesthetics, culture, environment, fashion and lifestyle; technology-push factors such as new materials and techniques) • Discuss the key procedures in a product design project (e.g. design data collection, product styling and a market positioning analysis) • Develop a design strategy and turn it into an action plan • Display enterprising behaviour (e.g. initiative, risk-taking, resourcefulness, responsibility, and adaptability) during the design process

2.4.2 Elective part: Technological Studies

The elective part is an extension of the compulsory part of DAT into particular areas of study. In solving design and technological problems, students need to develop solutions and employ technical knowledge. Problems can be from a range of technological areas such as electronics, robotics, visualisation, computer-aided manufacturing (CAM) and digital media.

As students may have different interests and inclinations, the elective part of the curriculum provides them with a choice of modules developed in the light of the current strengths of schools and advances in technology. However, modules may be updated and added or deleted according to the needs of students and further developments in technology.

In DAT, we encourage students to develop an interdisciplinary understanding of technology. To this end, they have to choose two out of the five proposed optional modules which are interrelated. Most technological developments encompass more than one area. The following are some of the possible combinations:

Orientation	**Optional Modules**	
Mechatronics-oriented	Electronics	Automation
Manufacturing-oriented	Automation	Design Implementation and Material Processing
Product design-oriented	Design Implementation and Material Processing	Visualisation and CAD Modelling
Computer graphics-oriented	Visualisation and CAD modelling	Creative Digital Media

Whichever modules are selected in the elective part, the following are essential learning components:

(a) The use and operation of the technologies, i.e. why the technologies are used, and the way they are operated;

(b) Technological principles and systems, i.e. principles that underlie technological developments, such as reliability, fitness for purpose, efficiency, safety, ergonomics and aesthetics;

(c) The nature of technological practice, i.e. components of a technological system and how they function in practice; and

(d) The effects of technological processes and progresses, i.e. appraisal of their impact.

Coursework – such as 'hands-on' practical exercises involving the development of operational and manipulative skills, experiments exploring technological systems, and task-based activities involving the use of specific skills and knowledge – can be used to enable students to use, develop and adapt technologies.

The optional modules in the elective part include the following learning elements:

ELECTIVE PART
Technological Studies

Module 1 Automation

Basics of Control Systems
- Sequential Control Systems
- Closed-Loop Systems
- Sub-systems

Pneumatics
- Pneumatic Components and Symbols
- Pneumatic Circuits and Systems
- Electro-pneumatic Systems
- Applications of Pneumatic / Electro-pneumatic Systems

Programmable Control Systems
- Basic Working Principles of Programmable Control Systems
- Use of Programmable Control Systems
- Problem-solving Using Programmable Control Technology

Robotics
- Basic Structure of Robot Arms
- Applications of Robots

Module 2 Creative Digital Media

Media Literacy
- Communication via Digital Media
- Digital Media Products and Related Business
- Social, Economic and Technological Factors

Digital Media Design
- Conceptual Development
- General Rules of Visual Composition
- Basic Principles of Communication Design in Creating Digital Media

Digital Media Production
- Project Planning and Idea Presentation Methods
- Manipulation of Visual and Audio Equipment
- Application Software

Module 3 Design Implementation and Material Processing

Materials, Components and Systems
- Properties and Choice of Materials
- Materials and Structures
- Mechanisms
- New Materials

Processing and Manufacturing
- Manufacturing Processes and Techniques
- Scale of Production
- Quality Assurance and Quality Control

Computer-aided Manufacturing (CAM)
- Computer Numerical Control (CNC) and CAM
- Basic Concepts of Computer Integrated Manufacturing (CIM) and Flexible Manufacturing System (FMS)
- The impact of CAM on Manufacturing

Module 4 Electronics

Electronic Signals, Devices and Circuits
- Electronic Components and Circuits
- Ohm's Law and Its Application
- Digital and Analogue Signals
- Logic Circuits

Analogue and Digital Electronics
- System Electronics
- Op-amp Operation
- Latch Circuit
- Memory and Counter

Integrated Circuit, Micro-controller and Interfacing
- Types of IC
- Programmable Systems
- Micro-controller Basics

Evolution of Electronics in Modern Society
- Impact of Emerging and Converging Technologies
- Miniaturisation of Electronic Products

Module 5 Visualisation and CAD Modelling

Product Visualisation and 3D Modelling
- Visual Impact of Graphics
- 3D Modelling Concepts

Technical Visualisation
- Pictorial Drawing
- Engineering Drawing
- Standards, Conventions and Symbols
- Data Presentation

Computer-aided Design (CAD)
- 'Virtual' Prototypes
- Criteria for Computer Modelling Techniques
- CAD Software
- The Impact of CAD on the Design Process

Applications
- CAD and Visualisation

<u>Module 1</u> Automation

This module enables students to explore the design of control systems. It focuses on the basics of systems, pneumatic control, programmable control, and robotics.

Topics *Students should learn*	Outcomes *Students should be able to*	Explanatory notes
Basics of control systems • Sequential control systems • Closed-loop systems • Sub-systems	1. Interpret sequential control systems 2. Interpret closed-loop control systems 3. Interpret the stages and functions of sub-systems in a system 4. Evaluate products with control functions	• Examples of sequential control system (e.g. operation of a washing machine and traffic lights) • Illustrate the key components in a closed-loop system (e.g. investigate the control of fluid level in a tank) • Use block diagrams to show the sub-systems in a car (e.g. the links between sub-systems in a large system) • Explain the applications of control systems (e.g. in a buggy, air conditioner and production line) and describe their control variables
Pneumatics • Pneumatic components and symbols • Pneumatic circuits and systems • Electro-pneumatic systems • Applications of pneumatic / electro-pneumatic systems	5. Describe and illustrate examples of the use of pneumatics in daily life and industry 6. Draw simple pneumatic circuit diagrams 7. Design and use simple pneumatic / electro-pneumatic systems to solve control problems	• Understand the basic functions of different components in pneumatic systems (e.g. valves, cylinders, filters, regulators, pumps, sensors, and solenoid) • Apply different components in pneumatic circuits • Explore the control of cylinder motions (e.g. speed regulation, logic control, and sequential control) • Design simple pneumatic circuits for solving control problems • Discuss how pneumatic systems are applied (e.g. automatic doors, automated production lines, and punching machines) • Discuss the advantages, limitations and safety considerations of pneumatic control systems

Topics *Students should learn*	Outcomes *Students should be able to*	Explanatory notes
Programmable control systems • Basic working principles of programmable control systems • Use of programmable control systems • Problem-solving using programmable control technology	8. Understand the basic working principles of programmable control systems 9. Use programmable control boards and kits 10. Select input and output devices in programmable control systems 11. Construct simple programmable control systems to solve control problems 12. Understand the industrial applications of programmable control systems	• Explore the basic architecture of a programmable control system • Interpret the use of interfaces and I/O ports: digital and analogue ports • Use of sensors and output devices (e.g. stepper and servo motors) • Use of various programmable control tools such as programmable logic controllers (PLCs), micro-controller boards or learning kits, and personal computers • Explain how programmable control systems are driven by the following: - Personal computers - Micro-controllers - PLCs • Use of application software for data capturing/logging, process controlling, and power driving (e.g. the design of a computer-controlled fire alarm system) • Discuss the applications of programmable control and their advantages and limitations
Robotics • Basic structure of robot arms • Applications of robots	13. Understand the basic configuration of robot arms 14. Understand the use of robots in daily life and industry	• Explain the components of a simple robot arm (e.g. programmable mechanical manipulator, end-effector, structure, joints, axes of motion, actuator, and feedback device) and methods of teaching the arm movement and position (e.g. lead by nose, teach pendant, and off-line programming) • Describe different types of robot arms grouped by their movements and functions (e.g. mechanical movements, pick and place, welding, and spray painting) • Discuss the advantages and limitations of robots (e.g. social impact, accuracy, safety, repeatability, economy and applications)

Module 2 ***Creative Digital Media***

This module enables students to explore ways to convey messages and information in a media-rich society. It focuses on the development of communications for the digital age, and the basic techniques of digital media design and production.

Topics *Students should learn*	Outcomes *Students should be able to*	Explanatory notes
Media literacy • Communication via digital media • Digital media products and related business • Social, economic and technological factors	1. Understand various modes and stages of communication in different contexts 2. Identify the features of communication via digital media 3. Compare different digital media products in the local and global markets 4. Evaluate the pros and cons of a media-rich society in terms of social (including cultural and historical), economic and technological factors	• Give some examples on the modes of communication such as human-computer interaction (HCI) and communication among people • Collect examples (e.g. magazines or TV commercials) to analyse the components and stages of the communication processes employed, e.g.: - source vs destination - sender vs receiver - message-carrier/channel/medium - encoding vs decoding • Research and analysis on the properties of communication in different media, e.g. the sequential presentation of messages and information in printed books (i.e. traditional media), and the non-sequential/ hyper-linked presentation of messages and information in interactive compact disc read-only-memory (CD-ROM)/ electronic books (i.e. digital media) • Conduct a case study of the social issues/ impact of digital media • Study the chronology of major technological advances in digital media

Digital media design • Conceptual development • General rules of visual composition • Basic principles of communication design in creating digital media	5. Describe the relationship among text, sounds, static and dynamic images/graphics and animation/video in communication via digital media 6. Create ideas for conveying messages and information efficiently and effectively/meaningfully 7. Apply the general rules of visual composition in digital media design 8. Evaluate the usability, readability and interactivity of different digital media products by referring to the basic principles of communication design	• Search for and analyse examples, such as 3G mobile phones and websites, to value the interactions among graphics, text, and sounds of the user interface • Conduct a study of an interesting advertisement to interpret/deduce the signification of the movies or still/dynamic images involved with the basic concepts of semiotics, e.g.: - iconic, indexical and symbolic signs - 'signifier' and 'signified' of a sign - denotation and connotation • Organise activities with the application of general rules of visual composition (e.g. golden ratio, framing, cross lines, laws of grouping and shape-recognition) in digital media design • Explore the usability, readability and interactivity embodied in common digital media products such as computers/mobiles/online games
Digital media production • Project planning and idea presentation methods • Manipulation of visual and audio equipment • Application software	9. Identify the need for digital media production 10. Outline and distinguish different building blocks in digital media production 11. Manage the activities of digital media production 12. Carry out a simple digital media production with the use of appropriate visual and audio equipment and application software	• Conduct the following pre-production activities: - production timeline - scriptwriting - storyboarding - scene and props set-up • Organise learning activities such as sound recording, photo taking and video shooting • Practise audio and image processing techniques such as: - image capture and editing - special effects and audio mixing - video capture and editing • Produce 2D and 3D animation, and virtual reality presentation • Design and produce a digital media presentation to introduce school life in an open day • Conduct a case study of the National Aeronautics and Space Administration's (NASA) 'Pioneer Project', focusing on the conceptual development of using different media to present the Earth to other creatures in space

Module 3 ***Design Implementation and Material Processing***

This module enables students to explore the conversion of some readily available materials and components into final products. It focuses on the implementation of design and material processing, and on how computer-aided manufacturing (CAM) is used in production.

Topics *Students should learn*	Outcomes *Students should be able to*	Explanatory notes
Materials, components and systems • Properties and choice of materials • Materials and structures • Mechanisms • New materials	1. Understand that properties and working characteristics influence the choice of materials and components 2. Understand the strength of material and design appropriate structures in a system 3. Apply mechanisms for control systems 4. Understand the use of new materials	• Explore various materials for particular applications in design, fabrication and control (e.g. classification, working properties, quality, selection and testing, and standard components) • Explore how the choice of materials affects a design • Apply the concept of strength and stiffness of structure in design (e.g. safety factors, simple calculations: Young's modulus of a material, loads experienced by the members of a structure in equilibrium, and bending moment and shear force diagrams of simply supported beams and cantilevers) • Apply simple calculations to determine the mechanical advantage (M.A.), velocity ratio (V.R.), efficiency and torque of a mechanical system • Study the use of modern and smart materials (e.g. solar panels, thermo-ceramics, liquid crystal displays (LCD), carbon fibres and nano-materials, and shape memory alloys) in industry through research and exploration
Processing and manufacturing • Manufacturing processes and techniques • Scale of production • Quality assurance and quality control	5. Select, explain and execute appropriate manufacturing processes and techniques 6. Explain when it is most appropriate to use different scales of production 7. Consider the application of quality control in production	• Suggest appropriate manufacturing processes for production (e.g. manual or automated, jig and fixture, tools, machinery and equipment, fabrication processes, forming and moulding, and finishing processes) • Deduce from production analysis how and why products are manufactured (e.g. using one off / batch / mass production) • Study, as in a case, a structured management process for quality manufacturing (e.g. quality assurance, quality control, accuracy and tolerances, and quality standards in production)

Topics *Students should learn*	Outcomes *Students should be able to*	Explanatory notes
CAM • Computer numerical control (CNC) and CAM • Basic concepts of Computer Integrated Manufacturing (CIM) and Flexible Manufacturing System (FMS) • The impact of CAM on manufacturing	8. Understand the use of CNC machines and CAM systems in industry 9. Understand CIM and FMS, and their wider application in industry	• Discuss the advantages and limitation of some commonly-used computer numerically controlled machines and computer-controlled tools (e.g. laser cutter, lathe, milling machine, and engraver) • Explain how CAD and CNC can be interfaced to form a CAD/CAM system • Explain the impact of CAD/CAM on manufacturing (e.g. Just-in-time (JIT), mass customisation, production logistics), and compare and contrast the advantages and disadvantages of CAM with traditional manufacturing methods (e.g. time, costs, waste management, standardisation and reliability)

***Module 4* Electronics**

This module enables students to explore the design of electronic circuits. It focuses on electronic control and electronic products.

Topics *Students should learn*	Outcomes *Students should be able to*	Explanatory notes
Electronic signals, devices and circuits • Electronic components and circuits • Ohm's law and its application • Digital and analogue signals • Logic circuits	1. Define electric current, resistance, potential difference and transducer 2. Describe the functions of commonly used electronic components 3. Calculate the current throughout and voltage across resistors in series and parallel circuits by using Ohm's Law 4. Power consumption of electronic systems (Power = Voltage x Current) 5. Explain the difference between direct and alternating current signals 6. Explain how a potential divider works 7. Explain the difference between a digital and an analogue signal 8. Understand the use of truth tables and Boolean expressions 9. Analyse electronic logic design problems and use circuits with appropriate logic gates to solve problems 10. State the use of a transistor as a driver and a switch	• Give examples of analogue and digital electronic devices • Commonly used electronic components: resistor, potentiometer, thermistor, light dependent resistor, capacitor, diode, light emitting diode, transistor, logic gates, lamp, motor, speaker, buzzer, microphone, fuse, switch, push button, relay, and transformer • Conduct experiments to verify Ohm's Law • Practical applications of potential divider • Logic gates family (e.g. complementary metal oxide semi-conductor (CMOS) series) • Use electronic learning kits to verify the properties of different logic gates • Design logic circuits with the use of combined logic gates (e.g. simple fire alarm system)

Topics *Students should learn*	Outcomes *Students should be able to*	Explanatory notes
Analogue and digital electronics • System electronics • Op-amp operation • Latch circuit • Memory and counter	11. Explain how a systems approach (I-P-O) can be applied to the design of electronic circuits 12. State the characteristics of an ideal op-amp 13. Describe how an inverting and a non-inverting op-amp operate, and their practical use 14. Explain the need for memory in a logic system 15. Understand the use of a D-type flip-flop as a basic type of memory 16. Apply simple analogue and digital circuits	• Identify different parts related to the input, process and output of electronic learning kits • Operational amplifiers (e.g. 741) • Construct a voltage comparison light-controlled on-off switching circuit using an op-amp based comparator; students need to make reference to the specifications of the op-amp used • Construct a D-type flip-flop circuit to demonstrate how a latch works • Use electronic learning kits to build a ripple counter with D-type flip-flops
Integrated circuit, micro-controller and interfacing • Types of IC • Programmable systems • Micro-controller basics	17. Identify the common types of IC being used in electronics products 18. Understand the use of a micro-controller 19. Describe, with the use of a simplified block diagram, the different parts of a micro-controller and a micro-controller system 20. Recognise that a 'bus' is a link that transports information within a digital system 21. Explain the advantages and disadvantages of software-controlled systems compared to hard-wired systems 22. Apply simple interfacing circuits for micro-controller based systems	• Explore the usage of different ICs by disassembling daily electronic products • Appreciate that a micro-controller is a multi-purpose programmable integrated circuit with a wide range of functions • Micro-controllers (e.g. 8051 series) • Use flowcharts or pseudo codes to illustrate the simple operations executed by micro-controller • With the use of micro-controller learning kits, develop projects for specific tasks (e.g. fire alarm and timer) • Conduct research on the Internet on data sheets or catalogues of micro-controllers • Appreciate the interfacing of sensors and actuators • Identify different 'buses' being used in a micro-computer system (i.e. data, address and control buses) • Identify a range of electronic products used in daily life that can incorporate micro-controllers • Search catalogues to find the use of micro-controllers in domestic products such as a microwave oven and washing machine • Construct commonly used systems, such as pulse generators, by using traditional components and

Topics *Students should learn*	Outcomes *Students should be able to*	Explanatory notes
		programmable ICs; contrast the differences between the two systems
Evolution of electronics in modern society • Impact of emerging and converging technologies • Miniaturisation of electronic products	23. State the impact of emerging and converging electronic products in society 24. State the impact of the miniaturisation of electronic products on society	• Conduct research on the Internet, newspapers and other media on the development, basic principles and use of these technologies in, for example, portable storage and global communication systems • Analyse critically the pros and cons of emerging and converging technologies with regard to their influences on daily life • Investigate and compare the conventional and modern ways of processing audio (e.g. tapes (analogue) vs MP3 (digital signals)) and visual (e.g. optical vs digital photograph) information

***Module 5* Visualisation and Computer-aided Design (CAD) Modelling**

This module enables students to explore the methods of product modelling through visual images and CAD. It focuses on visual communication and 3D modelling in product development.

Topics *Students should learn*	Outcomes *Students should be able to*	Explanatory notes
Product visualisation and 3D modelling • Visual impact of graphics • 3D modelling concepts	1. Apply visual impact to enhance graphics 2. Develop solutions modelled in appropriate materials to convey 3D concepts	• Improve the presentation of drawings (e.g. graphic artwork, advertising, packaging and layout) and apply enhancement techniques (e.g. colouring, shading, highlighting and rendering) • Apply a wide range of materials (e.g. card board, medium density fibreboard (MDF), high density foam board (HDFB), acrylic, and common alloys) and techniques (e.g. surface development, mock-up fabrication, and prototyping) appropriate to modelling and prototyping (e.g. architectural and product design) • Compare the application of physical and visual models (e.g. effects, tools and materials used, storage) in the development, description, production and communication of information about products
Technical visualisation • Pictorial drawing • Engineering drawing • Standards, conventions, and symbols • Data presentation	3. Apply a wide range of pictorial drawing techniques to communicate design ideas 4. Apply a wide range of engineering drawing techniques to communicate design ideas 5. Apply a wide range of presentation techniques to communicate design ideas and data 6. Understand the use and importance of standard practice, conventions, abbreviations and symbols	• Use perspective sketches to illustrate design ideas (e.g. of product, architecture, interior design, and window display) • Prepare working drawings (e.g. orthographic projection, assembly and sectional drawing, dimensioning, and detail drawing) for production • Present data (e.g. charts and diagrams) and graphic ideas (e.g. sequential illustrations, logos, symbols, and signs) for various design communications (e.g. packaging, instruction, and exhibition) • Apply standard practice in design communication (e.g. engineering drawing, architectural drawing, and electrical drawing)

<table>
<tr>
<td>Computer-aided design
• ‘Virtual’ prototypes
• Criteria for computer modelling techniques
• CAD software
• The impact of CAD on the design process</td>
<td>7. Understand how ‘virtual’ prototypes for visualising design can enhance the product development process
8. Compare and contrast different computer modelling techniques
9. Explain the criteria that enable designers to select appropriate computer modelling techniques
10. Construct models of products with CAD software</td>
<td>• Analyse how CAD can enhance the research and development of products (e.g. simulation and analysis, modification, parametric design, data storage and communication, prototyping, data transfer to CAM systems and conserving resources)
• Compare different CAD modelling techniques (e.g. 2D and 3D modelling) and graphic systems (e.g. vector and raster graphics) in terms of their ability and constraints in supporting various applications (e.g. printing, vinyl cutting, laser cutting, CNC, rapid prototyping, graphics and multi-media presentation)
• Selection of the appropriate CAD modelling techniques for different professions (e.g. graphics design, multi-media production, interior and architectural design, engineering design, product design and manufacturing)
• Create graphic images and computer models of products: 2D and 3D product design, 3D animation, architectural and interior design models</td>
</tr>
<tr>
<td>Applications
• CAD and visualisation</td>
<td>11. Understand the use of CAD and visualisation in daily life and industry</td>
<td>• Conduct case studies to understand the modern uses of CAD and visualisation:
- animation (e.g. 3D scanning and motion capture)
- logistics (e.g. simulation)
- mass property analysis (e.g. mass, volume, surface area, centre of gravity)
- structural analysis (e.g. stress and strain, impact test)
- virtual reality of 3D design (e.g. simulate a ‘walkthrough’ of a virtual space)
- educational use (e.g. spatial concept, visual impact)</td>
</tr>
</table>

2.4.3 Coursework

Coursework is an integral part of learning and teaching in DAT in which students learn through doing. Through coursework, knowledge and understanding of technology can be promoted in a practical manner. It is essential to engage students in technological activities to enhance their creative and critical thinking. Most of the curriculum content can be delivered through coursework. Coursework is also a good tool for formative assessment as it reveals what students know and don't know, and their strengths and weaknesses.

Students are given the opportunity to demonstrate their capabilities in technology and design by participating in a variety of coursework activities. Coursework may include:

- research in technology (such as case studies, reading, product analysis, interview and observation);
- technology explorations (such as 'hands-on' practical, experimental, and task-based activities); and
- open-ended learning activities (such as design projects and problem-solving activities).

In coursework, students are expected to demonstrate their learning through providing evidence that they have worked on:

- **Design Process**
  - identification of a design need
  - statement of design project
  - acquisition of the necessary skills
  - modelling and fabrication of a prototype
  - assessment of the feasibility, implementation, and value of the design
- **Technological Understanding**
  - Understanding the operating principles and industrial practices of related technologies
  - innovative uses of technology
  - presentation of work and solicitation of feedback
- **Technological, Social and Entrepreneurship Awareness**
  - appreciation and critique of a design from a variety of perspectives
  - assessment of the social value and impact of a product and/or a system
  - decision making in design, manufacturing and marketing a product

Chapter 3 Curriculum Planning

This chapter provides guidelines to help schools and teachers to develop a flexible and balanced curriculum that suits the needs, interests and abilities of their students, and the context of their school, in accordance with the central framework provided in Chapter 2.

3.1 Guiding Principles

One aim of the senior secondary curriculum is to widen the knowledge base of every student while at the same time enabling learning in depth in some subjects to prepare for further study. Schools should develop and provide a broad and balanced school-based curriculum. Careful curriculum planning should aim not only to facilitate subject learning, but also to cultivate generic skills, and positive values and attitudes. TE is one of the eight KLAs that each student is entitled to study in the senior secondary curriculum.

In the modern world, our personal and social values are shaped through interaction with technologies; and the effects appear to be multiplying very rapidly as new and more powerful technologies become part of our lives. Students who choose to study technology education elective subjects in the senior secondary curriculum will acquire the ability to intervene creatively in the man-made world by designing and making products and by assessing their social impact. The study of TE KLA is an effective platform for nurturing students' skills in collaboration, communication, creativity, critical thinking, problem-solving, and information technology.

Most TE KLA electives require equipment, software and material. In most schools, the existing facilities are considered adequate for offering the electives. Schools should focus on the interests, needs, and abilities of their students in planning their school-based curricula. Where they anticipate problems associated with low enrolment, they may consider collaborating with other schools to form networked classes for the electives.

The DAT curriculum framework sets out the general requirements of the subject. Schools are strongly encouraged to use the framework to plan their own curriculum.

3.2 Progression

The order of teaching for the different parts of the curriculum will depend very much on teachers' individual preferences and approaches to the subject.

The teaching should be designed and time-tabled in schools in ways that help students to explore their interests as far as possible in S4, and then to progress effectively to their chosen studies in S5 and S6.

An example of progression at senior secondary level is shown below:

Level	Core Subjects	Elective Subjects				Other Learning Experiences
S6	Chinese Language, English Language, Mathematics, Liberal Studies	DAT (optional modules)	X2	(X3)		• *Moral and civic education (such as environmental issues and concerns)* • *Career-related experience (such as visits to industries)* • *Community services (such as designing aids for people in need)*
S5	Chinese Language, English Language, Mathematics, Liberal Studies	DAT (optional modules)	X2	(X3)		
S4	Chinese Language, English Language, Mathematics, Liberal Studies	DAT (compulsory part)	X2	(X3)	(X4)	

(X3) and (X4) - optional

For students with learning needs that cannot be met in the proposed curriculum, other learning opportunities such as ApL courses can be considered. In this case, the compulsory part of DAT studied by students in S4 will provide them with foundation knowledge and skills in technology and design leading them to study design or applied technology related ApL courses in S5 and S6.

The foundations for most of the key concepts in DAT (i.e. the compulsory part) can be studied at an early stage through an integrated learning approach involving, for example, case studies.

For more in-depth study, students can then choose two optional modules according to their interests. These two optional modules can be taken concurrently or sequentially.

Some suggested teaching sequences are given below for reference.

Case 1

S6	Compulsory part	Coursework
S5	Optional modules (1) and (2)	
S4		
	Compulsory part	

- The compulsory part serves as introduction and conclusion in S4 and S6 respectively.
- The two optional modules are studied concurrently and serve as ‘tasters’ in S4.

Case 2

<table>
<tr><td>S6</td><td rowspan="2">Optional modules (1) and (2)</td><td rowspan="3">Coursework</td></tr>
<tr><td>S5</td></tr>
<tr><td>S4</td><td>Compulsory part</td></tr>
</table>

- Solid foundation study of the compulsory part is built in S4.
- The two optional modules are studied concurrently in S5 and S6.

Case 3

<table>
<tr><td>S6</td><td colspan="2">Compulsory part + Optional modules (1) and (2)</td><td rowspan="3">Coursework</td></tr>
<tr><td>S5</td><td colspan="2">Optional module (2)</td></tr>
<tr><td>S4</td><td>Compulsory part</td><td>Optional module (1)</td></tr>
</table>

- Some basic elements of the compulsory part and one optional module from the elective part are studied in S4 as ‘tasters’.
- The two optional modules are studied sequentially in S4 and S5.
- An integrated study of compulsory and optional modules is arranged in S6.

Students who have not studied DAT in S4 can opt to take DAT commencing in S5, though they may need to spend some extra time on the compulsory part of the curriculum.

3.3 Curriculum Planning Strategies

Students vary in many respects, and so do teachers and schools. In planning the DAT curriculum, implementation strategies may be based on students’ ability, teachers’ expertise, the availability of school facilities and resources, and the timetable in schools.

3.3.1 Curriculum planning

Curriculum planning starts at the junior secondary level where teachers will have ample opportunities to discover what students have achieved in the area of DAT and to help them to identify their interests, so that they choose the appropriate elective options to further their study in specific areas of DAT.

The sequence in which the learning elements are presented in this Guide should not be regarded as a fixed teaching order. Individual learning elements should be studied as integral parts of the whole curriculum, not as separate entities. (Please refer to Chapter 4 – 'Learning and Teaching' for further details.)

Schools are encouraged to develop their own school-based learning and teaching resources according to the needs, interests and abilities of their students whenever feasible. A cooperative effort by members of the DAT panel is necessary for this purpose. For example, teachers working at the same level can meet, say, once a term to plan/design a unit in the scheme of work and subsequently use the materials and activities developed with their classes. Also, peer observations of lessons, followed by discussion among the teachers, can improve the quality of learning and teaching materials.

3.3.2 Developing essential skills

Teachers should ensure that all students are given opportunities to develop a range of essential skills, values and attitudes when planning DAT learning and teaching activities for them. Some illustrative examples are given below:

- Generic skills – Open-ended learning activities can assist students to develop a number of generic skills such as thinking, creating, identifying values and managing complexity and uncertainty.
- Independent learning – DAT encourages students to think and learn independently. It is possible to develop learning activities in DAT that cater to the gifted, the underachievers and students of both genders.
- Self-regulation – Students should be given opportunities for complex practical activities that take time to accomplish, so that they can reflect on what they are doing, and link their learning from one day to the next. The technological issues and problems considered must be complex enough so that they cannot be resolved or solved quickly in one lesson. When tasks have high levels of cognitive and practical demand, students are compelled to reflect and to control their own learning. In this respect, student-driven learning, such as open-ended design projects and case studies initiated or selected by students themselves should be promoted.
- Values and attitudes – Design is a process which aims at improving the natural and technological world. Such improvements may be value-laden. Teachers need to help students to identify the values underlying the decisions made and the products realised.

3.3.3 Integrating learning with assessment

Assessment is a powerful educational tool for promoting effective learning. Assessment activities should be integrated into classroom lessons. The assessment requirements for the school-based assessment component of the public examination for DAT are further elaborated in Chapter 5.

3.3.4 Catering for learner diversity

Flexibility should be provided to enable students to select modules in the elective parts according to their interests. In addition, students learn in different ways, and teachers need to provide a range of learning activities to respond to these differences.

3.4 Curriculum Management

A thorough understanding of the rationale, aims, learning targets, key concepts and critical features of the DAT curriculum among all those involved in DAT will greatly enhance the quality of the learning and teaching. The following are some major issues that schools can take into consideration when making decisions on how to manage the curriculum effectively.

3.4.1 Flexible use of learning time

The time allocations suggested in Section 2.3.2 are to be seen as rough estimations. Schools are encouraged to make flexible use of learning time to facilitate learning and teaching during and outside school hours.

Schools can arrange double or triple period sessions per week/cycle. Also, half-day or whole-day sessions may be necessary for specific tasks and activities, and for student attendance at networked classes where required.

The study of DAT should not be confined to the classroom. Learning time outside school hours and/or regular DAT sessions can be assigned for various purposes. These include:

- Part of the coursework requirements such as literature and information searching, data collection, visits to museums and galleries, design tasks, public presentations and exhibitions; and
- Life-wide learning activities such as participating in technology competitions and services, organising technology orientation activities for schools, visiting local industries, and developing career-related experiences.

3.4.2 Special rooms and facilities

The DAT curriculum is designed in such a way that it can be offered with the existing facilities in schools. For its implementation, schools should make the following facilities available for carrying out learning activities:

- An area for equipment-based activities for the compulsory part and the optional modules such as the 'Design Implementation and Material Processing'; and
- An area for IT-related activities for optional modules such as 'Visualisation and CAD Modelling' and 'Creative Digital Media'.

Schools with equipment-based rooms can choose to use the available facilities for the practical activities in the subject. Those without special rooms for DAT, can consider using their science laboratories/computer rooms with some enhancements (e.g. enhanced computer rooms for the optional 'Visualisation and CAD Modelling' and 'Creative Digital Media' modules; and enhanced science laboratories for the compulsory part and the optional 'Electronics' and 'Automation' modules)

In order to provide students with a wider choice of elective subjects, as well as optional modules for the elective part, schools might consider innovative ways of offering the senior secondary curriculum – for example, partnerships with neighbouring schools with different facilities to offer elective subjects and optional modules, hiring services from tertiary institutions, and partnerships with industry.

3.4.3 Roles of different personnel in schools and professional development

DAT teachers, TE KLA co-ordinator / DAT panel chairperson and school heads should work as a team in the planning, development and management of the DAT curriculum. Schools are encouraged to formulate staff developments plans so that all personnel concerned can keep abreast of the latest curriculum development, teaching strategies, subject knowledge and assessment requirements.

- **DAT teachers**

  DAT teachers can contribute to the planning of the DAT curriculum by working in line with the school policy and assisting the TE KLA co-ordinator / DAT panel chairperson as individuals and in collaboration with other DAT teachers. They can also take on the role of curriculum leader by initiating innovative curricular changes. They should foster a motivating learning environment among students and strengthen their learning to learn skills.

- **TE KLA co-ordinator / DAT panel chairperson**

  The TE KLA co-ordinator / DAT panel chairperson can help to develop and manage the DAT curriculum, as well as monitor its implementation. They act as a 'bridge' between the school administrative personnel, such as the school head, and DAT panel members. They should lead the panel in planning an appropriate programme, facilitate the professional support and development of panel members, manage resources including special rooms, and keep a clear record of the work of the panel.

- **School heads**

  School heads should take the leading role in planning, directing and supporting school-based curriculum development. As curriculum leaders, they may focus on the following:

  - Planning curriculum, instructional and assessment policies in line with the central curriculum framework;
  - Deploying suitable teachers as TE KLA co-ordinator / DAT panel chairperson and DAT teachers. Depending on the nature of the topics, team-teaching, drawing on the expertise of different teachers, may be needed;

- Assigning special rooms (e.g. equipment-based rooms, laboratories and computer rooms) and allocating resources (e.g. funding, time-tabling, supporting staff) appropriately to promote effective learning and teaching of DAT (Please refer to Chapter 6 - 'Learning and Teaching Resources' for more information); and
- Promoting cooperation with other schools to offer networked classes, the professional exchange of information, and the sharing of good practices.

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Chapter 4 Learning and Teaching

This chapter provides guidelines for effective learning and teaching of the DAT curriculum. It is to be read in conjunction with Booklet 3 in the *Senior Secondary Curriculum Guide* (2009), which provides the basis for the suggestions set out below.

4.1 Knowledge and Learning

The suggestions on pedagogy presented in this chapter, and the guiding principles that underlie them, are based largely on the following views of knowledge and learning in DAT and existing good practice in schools.

4.1.1 Views of knowledge

Technological knowledge is currently exploding exponentially. The knowledge and technology to be learned by students at school should not be limited to a fixed body of knowledge or a curriculum crammed with an excessive amount of knowledge. However, teachers do need to ensure that students are provided with updated, essential knowledge that can be integrated and connected with society and its culture. Students are encouraged to explore a wider range of technological knowledge through coursework in DAT.

While technologies can become obsolete in a short period, there are certain common features in the process of creating technological change that are worth learning. Practical experience in solving design and technological problems for the real world demands task-related knowledge and skills. When tackling a real problem from inception to completion, students will face constraints of time, cost and resources. The process requires the capacity to identify shortcomings and take creative action to make changes and improvements in the course of undertaking a task. In the process of searching for information, applying technology, modelling solutions and evaluating feedback, students will develop task-related knowledge which they themselves have created. Such knowledge and capabilities in technology are essential for meeting the demands of a knowledge-based economy.

Learning and teaching activities in the DAT curriculum put emphasis on developing in students:

- technological capability to identify needs, problems and opportunities, communicate and evaluate solutions, and make informed decisions;
- technological understanding to appreciate the interdisciplinary nature of technological activities, and to grasp the concepts, knowledge and processes of different technologies; and
- technological awareness to be sensitive to the cultural and contextual dependence of developing technologies, and their impact on the individual, family, society and the environment.

Three knowledge dimensions can be identified in the learning and teaching of the DAT curriculum:

- **Procedural knowledge**

  Design is a dynamic ‘thought in action’ process – it involves interaction between mind and hands. The ideas imaged and modelled are expressed and realised through action. This process, which often happens unconsciously, is then developed, modelled, evaluated for fitness of purpose, realised as a prototype and evaluated further against intention, effectiveness and impact. The learning outcomes are that students will be able to know why and how to tackle problems, what to do and when to do it.

- **Technological knowledge**

  To develop a design for tackling a technological problem, students need to develop an understanding of the general principles underlying technological development, such as working principles, aesthetics, efficiency, ergonomics, feedback, reliability and optimisation. They also need to develop specific knowledge which is dependent on the technological area and the context within which they are working. Each technological area has its own technological knowledge and practice. The learning outcomes are that students will be able to understand the relevant technological concepts and procedures, and master the skills related to manual/practical techniques.

- **Societal knowledge**

  Students should develop an understanding of the ways in which beliefs, values and ethics promote or constrain technological development and influence students’ attitudes towards it. They should also develop an awareness and understanding of the impact of technology on society and the physical environment. The learning outcomes are that students will demonstrate awareness of social values and ethical issues that arise in the application of technology.

4.1.2 Views of learning

The integration of theory and practice is the key learning and teaching strategy in DAT. It encourages students to explore the synthesis of ideas and practices, and examine the effects of technology on society and the environment. Students can develop their knowledge in DAT through a combination of various learning activities:

- **Design project activities**

  Procedural, technological and societal knowledge are inter-connected. Design projects can serve as learning vehicles to integrate them.

  To solve real-life problems through design tasks, students need to learn to apply technological knowledge through a range of materials, tools and techniques, and to generate ideas and solutions. They also have to learn to adapt the procedural knowledge to identify, communicate and justify their intentions and manage production; and they need to learn to reflect on societal values and take responsibility for the consequences of their actions.

Design projects encourage the development of thinking and creative skills. The DAT curriculum provides opportunities for students to:

- select and organise information with regard to design research and idea-generation;
- communicate their design ideas in written, graphic and oral forms;
- work independently or as part of a team in developing possible solutions; and
- evaluate solutions critically and experiment with a range of tools, materials and techniques to realise their design ideas.

- **Case study activities**

  Students should be made aware of the relevance of the technology they are studying to the real world. Case studies on technology and design enable students to put their learning into an authentic context, and so provide an additional resource that can add a new dimension to learning about technology and design.

  Students must be actively engaged in the reflection process to enhance their technological capability. Case studies offer students the potential to explore and hypothesise about the initial problem from which a design emerges.

  In case study activities for DAT, students are given opportunities to:

  - evaluate a variety of products and consider how the designers chose to meet users' needs and what constraints they faced;
  - study a range of control products or systems in order to establish criteria for deciding which type of procedures and methods to use for a particular design task; and
  - investigate a range of products to see how common needs can be met in a variety of ways, and how the values and preferences of users can be catered for.

- **Exploration activities**

  Technology exploration activities include 'hands-on' practical, experimental and task-based activities. They put emphasis on developing particular skills and techniques and can be relatively short learning tasks which cover essential learning elements through undertaking a range of practical learning experiences. This type of task helps students to learn specific concepts and skills progressively.

  In technology exploration activities, knowledge and skill development can be brought about in a number of ways, including:

  - engaging students in 'hands-on' practical activities supported by judicious prompting and questioning to reinforce, practise and clarify new knowledge or skills;
  - encouraging students to use established knowledge and skills to tackle challenges; and
  - moving from simple, structured tasks to more complex, open-ended ones.

Example of a 'hands-on' practical task: laminated beams vs solid beams

Introduction
Construction projects often require beams to bridge long distances. Laminated wood structures are widely used in modern construction because of their strength and beauty.

Practical activity
Students are asked to manufacture laminated beams and test them against solid, sawed beams. During the test, students will discover how various glues may affect the strength of a finished product. They will also graph their results and draw conclusions based on the data gathered from the testing process.

(More information can be found in Appendix 1.)

4.2 Guiding Principles

The following section outlines guiding principles for effective learning and teaching in the DAT curriculum.

- **Building on prior knowledge and experience**

  Learning activities should be planned with the prior knowledge and experience of students in mind. When designing practical tasks, teachers should be flexible in adjusting the level of challenge and ensure that the tasks are manageable by students. In the light of students' prior knowledge and experience, teachers should vary the level and scope of their teaching to promote effective learning and interaction with their students.

- **Understanding learning targets**

  Teachers should have clear teaching targets in mind and employ appropriate learning and teaching strategies to achieve them. They should also ensure that students are fully aware of these targets.

- **Teaching for understanding**

  The pedagogies chosen should enable students to understand, think and act with what they know.

- **Using a wide repertoire of pedagogies and activities**

  A variety of activities, such as case studies, practical tasks and design projects should be employed so that different learning targets can be effectively achieved. In addition, teachers should adopt various pedagogical approaches – such as demonstrations, questioning, direct instruction, group work, discussion, visits, examining existing products, and using learning kits – to suit students with different learning styles.

- **Effective use of resources**

  A variety of teaching resources can be employed as tools of learning. For example, computers and CAD/CAM tools can help students to produce high-quality products, accurately and repeatedly, with a range of materials. One possible way to expand the availability of learning and teaching resources is to establish links and networks with other schools for sharing.

- **Aligning feedback and assessment with learning**

  Assessment is an essential part of learning and teaching. It provides useful information for teachers and students to enhance teaching and improve learning. Assessment helps students to recognise progress. Constructive feedback also allows them to plan their future learning.

- **Developing information technology skills**

  Opportunities should be provided for developing information technology skills in learning and teaching activities such as designing, data handling, communicating, modelling, control and manufacture.

- **Catering for learner diversity**

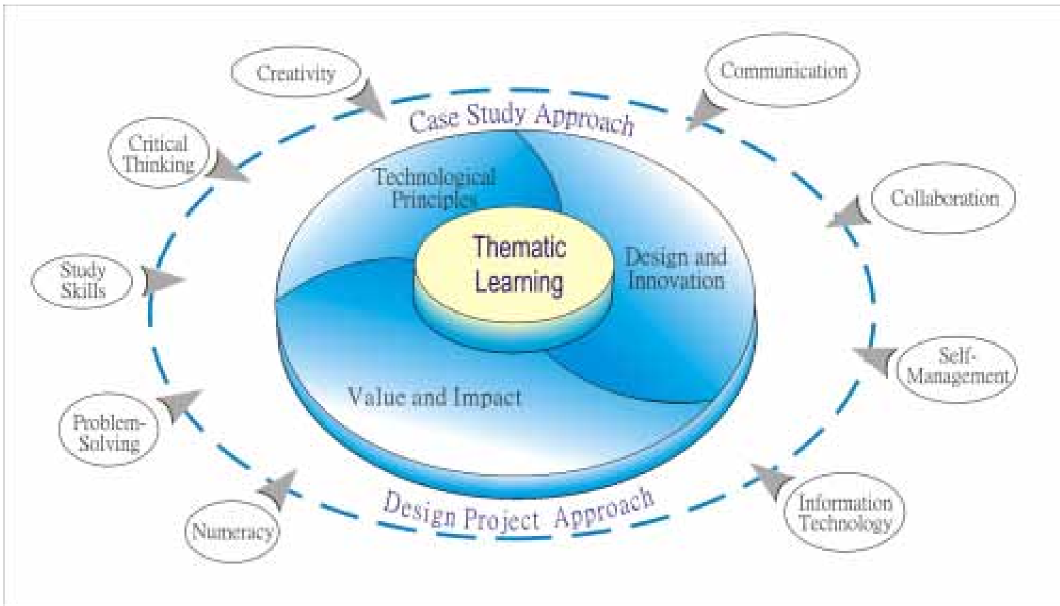
  Students have different characteristics, strengths and learning styles. Teachers should employ a wide range of strategies to respond to these differences.

4.3 Approaches and Strategies

4.3.1 Conceptual framework for learning in the DAT Curriculum

The conceptual framework for learning in the DAT Curriculum (Figure 4.1) involves a study of three interwoven strands: Technological Principles, Design and Innovation, and Value and Impact. Practical experiences, together with the learning of theories, are used to develop students' understanding, knowledge and skills in DAT. Students can develop the nine generic skills through their learning activities

Figure 4.1 *Conceptual framework for learning in the DAT curriculum*



Learning and teaching in DAT is structured around enquiry into a range of technological and design contexts. Students should be helped to appreciate the changing, complex and controversial nature of these contexts. Thematic learning is generally adopted to organise activities. As students explore the contexts, they are encouraged to bring in their own experience, and develop the attributes of innovation and entrepreneurship.

The case study and design project learning approaches adopted in DAT guide both the selection of content and the pedagogy for the curriculum. Case studies can be used for investigating tasks. They provide opportunities for students to carry out research in technology by reading, product analysis, interviews, observation and discussion. Design projects engage students in various problem-solving activities. In both approaches, 'hands-on' practical activities are essential elements.

The use of such approaches in DAT does not eliminate direct instruction. In fact, the subject calls for a variety of pedagogies, ranging from direct instruction to enquiry learning. The next section elaborates on how to choose appropriate strategies for different purposes in learning and teaching the subject.

- **Thematic learning**

Thematic learning is a powerful strategy, as people retain integrated information better than fragmented bits and pieces. Meaningful learning occurs when new knowledge and skills are embedded in context, through which students can see the connections among ideas.

As most of the DAT curriculum components and learning elements are interconnected, learning and teaching is best organised through themes.

Themes can also be used to link classroom learning to real-life experience. For example, events that take place in the special room of a school can be linked to those that occur in an industrial setting.

Learning should be personally relevant to students. When faced with authentic challenges that require 'learning by doing', enquiring, problem-solving and decision-making, students are more likely to explore a range of relevant possibilities. Learning activities organised around a theme can provide students with a purpose for learning - a meaningful context - and thus engage them in the activities. In this process, students find enjoyment and develop a sense of ownership and commitment in their learning.

Thematic learning in DAT may involve the exploration of areas of knowledge which are related to each other and include a variety of learning activities such as case studies, design tasks and practical exercises, e.g.

- Investigative and experimental work
- Individual and group activities
- Evaluation of existing products and systems
- Development of systems thinking to deal with problems
- Direct instruction/demonstration/discussion.

Illustration of related areas of knowledge in thematic learning

In a theme such as 'Gifts and Premiums', students are required to design and make a souvenir. They need to explore different related areas of knowledge such as product design, graphical communication and workshop realisation. This engages them in using research and development strategies to explore and discuss the design, and act as a designer to introduce an innovative design to potential clients or consumers.

(More information can be found in Appendix 2.)

Flexibility can be allowed in the design of learning activities in thematic learning. The activities can be more demanding in terms of design and technology for more able students, to extend and deepen their learning, or less demanding for less able students.

4.3.2 The case study approach

Case studies in DAT engage students in developing insights into innovation and in developing skills in research and communication. The outcomes can take various forms, including reports and oral presentations. After completing a case study, students are encouraged, where appropriate, to apply the processes utilised in the development of the innovation to explore and develop their own design projects. Some possible topics for case studies are as follows: (Please refer to Appendix 3 for more information.)

- The impact of technology on society
- Ethical and environmental issues
- Factors that affect the success of innovations
- The work of designers
- The influence of trends in society on design and production
- Quality, innovation and creativity
- The impact of emerging technologies.

Case studies can give rise to:

- **Contextual learning**

  A case study provides a context for studying a real-world design or technological problem that the students and teachers can work through together.

- **Interactive learning**

  In case studies students are required to discuss and explore various facets of each case. They define the problems and issues, propose solutions and courses of action, and defend their views among their peers. The teachers' role is confined to keeping the discussion on the topic, and ensuring that meaningful learning is taking place. Students are therefore given the opportunity to:
  - learn and develop key skills;
  - enhance their learning through group work or online discussion;
  - develop skills in gathering information; and
  - learn to analyse information critically.

- **Multi-faceted learning**

  Through the case study approach, students are engaged in various activities such as:

  – reading relevant articles to stimulate and maintain interest;

  – searching for and gathering relevant information;

  – reviewing ethical and social aspects of the topic; and

  – reflecting or engaging in dialogue with other students.

Example of a case study: the Lantau Link suspension bridge

This case study involves critical analysis of an innovation – Lantau Link. By conducting a detailed study, students will be able to: identify the factors underlying the success of the innovation; analyse ethical issues in relation to it; and discuss its impact on the sustainable development of Hong Kong.

Major aspects of technology and design to be explored in the case study include structure and materials (i.e. technology issues), product analysis (i.e. design issues) and design considerations (i.e. impact and constraints).

- ***The story – designers and their work***
  - Identify and describe the work of designers and engineers;
  - Describe their styles and the inspiration reflected in their work;
  - Compare and contrast factors affecting designing and producing, including: appropriateness, needs, functions, aesthetics, short- and long-term consequences of cost, structure, the use of the design, sustainability, energy, recyclability, safety, quality, durability, obsolescence and life-cycle analysis; and
  - Draw up a list of those who might be affected by the building and operation of the bridge. Use this list to find out if there are any 'losers' from the Lantau Link.

- ***Follow-up activities***

  Research – technological exploration:

  - Find out more about suspension bridges;
  - Make a simple sketch of a suspension bridge, and name the most important parts, and make notes to explain how each part helps to support the bridge; and
  - Find out about the properties of high tensile steel and how it differs from other forms of steel. Use the findings to explain why the designers chose this material for the cables.

  Design project – a suspension bridge

  - Apply a design process in the exploration and development of a suspension bridge;
  - Look back on something you have designed and made. How did you set about it? Did you work from concept to preliminary design to detailed design? How did your investigations help you to come to sound design decisions?
  - Present the findings and analysis in the group through presentations, debates or other forms of dialogue.

(Details of this example and another example are given in Appendices 4 and 5 respectively for reference.)

Examples of questions to promote dialogue in a case study

- Would the designer have done the same if he/she knew then what we know now?
- What variables were involved?
- What conflicts of values were there?
- How did the designer deal with these conflicts?

4.3.3 The design project approach

Design projects are usually longer, more open-ended tasks which allow students to apply their technological capability by drawing on their accumulated experience. They give students an opportunity to develop products that meet real needs and wants. Students can develop their own projects according to their interests and the resources available. They apply technological and design processes to create or modify products, production processes, systems, services or environments, and learn through the experience.

Project work should be open enough to challenge current ways of thinking and behaving, and should not be confined to a particular area or context. Each student has to be supported by the teacher throughout the project. Students must know what is required and expected of them for the project to be successful, and their progress should be monitored by teachers through regular interaction with them.

The design project should offer different levels of difficulty, so that students can tackle the task at a level suited to their abilities and previous experience – a new project offers a new challenge but is usually supported by previous tasks. According to the students' progress, and their level of autonomy and decision-making, the level of difficulty of design tasks can be gradually increased.

Project work is an integral part of the DAT curriculum. It provides students with experience of genuine technological thought and activity as they work through the design cycle. An example is given below to illustrate the possible scope of learning and teaching activities in design projects:

Example of a design project: information kiosks

An information kiosk is useful for providing new visitors with information.

Possible learning activities:

- Investigate a range of information kiosks used in different locations for various purposes.
- Propose the possible requirements for an information kiosk in a big amusement park.
- Develop a design strategy and turn it into an action plan with a major component of an information kiosk in one or a combination of the following aspects:
  - Physical kiosk: individual or a series for the whole park
  - Electronic/automatic display in the kiosk: for communication, decoration, or information display, etc.
  - Information in digital media: user interface, media information, etc.
- Design and produce the product.
- Evaluate the design solution and relevant social, economic, technical, legal and ethical issues.

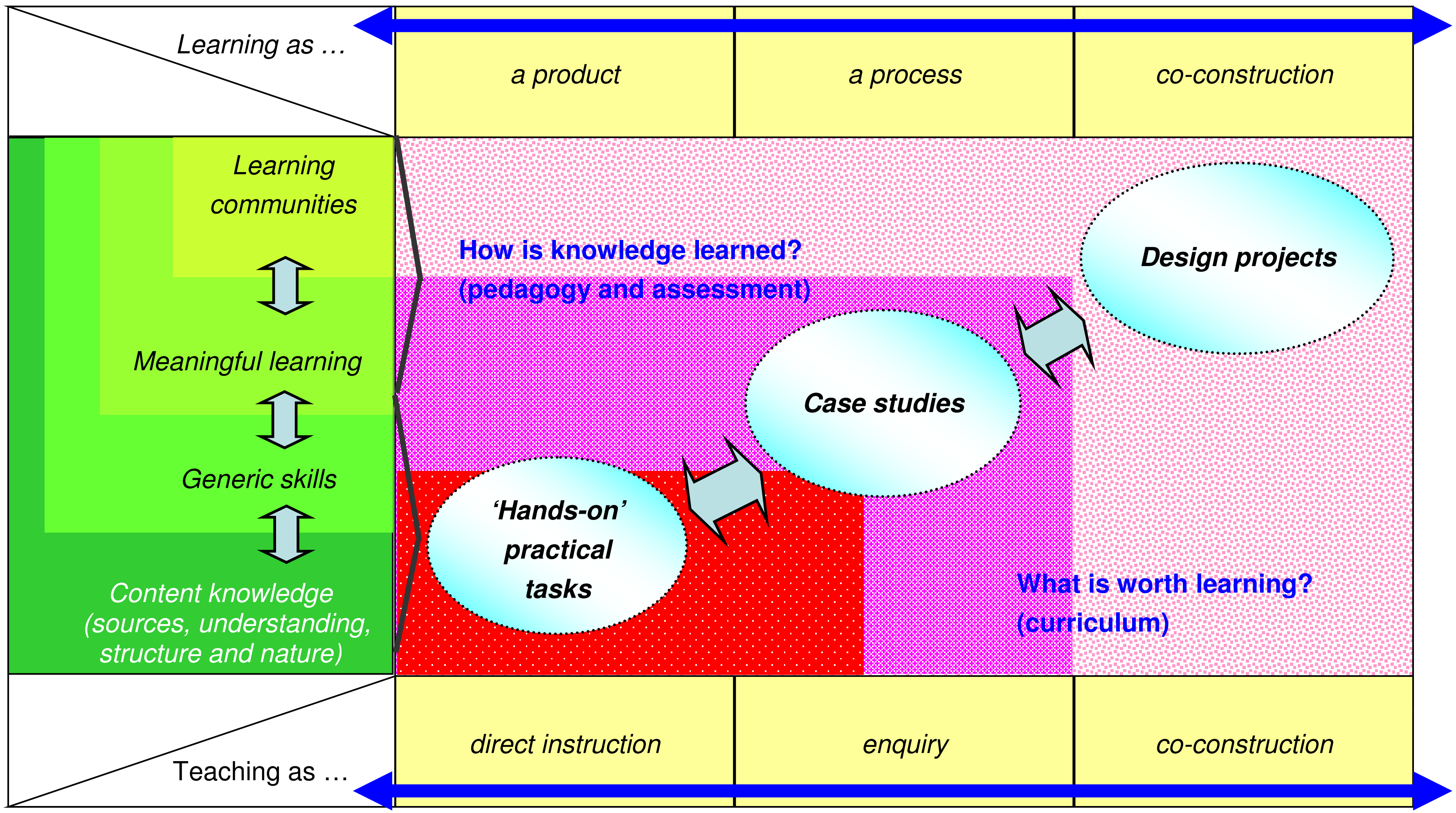
(More examples are given in Appendix 6 for reference.)

4.3.4 Choosing appropriate strategies: from content to pedagogy

In choosing learning and teaching strategies, a teacher should take into account the students' prior knowledge, experience, learning styles and abilities. A variety of learning and teaching activities, such as direct instruction, enquiry activities, and interactive activities can be suitably deployed to meet the different objectives of individual lessons and the varied needs of students. The most important guideline for choosing a suitable strategy is 'fitness for purpose'.

Given the wide range of objectives to be achieved in DAT lessons, there is no single pedagogical approach that can fit all the requirements. It is therefore advisable for teachers to adopt a wide repertoire of approaches. The figure on the next page (Figure 4.2) is the basic framework for learning and teaching adopted in the DAT curriculum. It shows the spectrum of pedagogical approaches available to suit different purposes.

Figure 4.2 Approaches to Learning and Teaching in DAT



There are many strengths in the learning and teaching practices in Hong Kong classrooms. Teachers should build on these strengths and widen their repertoire. They should not indiscriminately abandon their effective strategies to accommodate the new ones, however.

- **Teaching as direct instruction**

  Direct instruction is useful for passing on quick information and for modelling the skills to be learnt.

- **Teaching as enquiry**

  The essence of enquiry is to engage students in finding out information for themselves and making sense of it. It implies active involvement in the search for information leading to understanding and the construction of new knowledge. DAT emphasises the development of research skills to acquire new knowledge in a wider context and for problem-solving. DAT requires students to go beyond the accumulation of facts and information to meaning-making and the application of knowledge.

- **Teaching as co-construction of knowledge**

  Teachers and students are partners in the co-construction of knowledge in activities such as design projects. In such projects, students are encouraged to tackle open-ended problems in various contexts with which teachers may not be familiar, and therefore both parties have to search for knowledge and construct it together.

4.3.5 Examples of learning activities

The following examples illustrate some learning activities in DAT:

- **Writing a journal**

  Getting students to write journals in design portfolios allows them to write personal reflections when developing a design project. In the process of writing a journal, students develop knowledge, skills and abilities to make informed, responsible judgments, and they can develop self-awareness and critical thinking skills.

- **Presentations**

  Useful activities include oral presentations, role-play, poster presentations, multi-media presentations, or displays related to design projects.

- **Watching or giving demonstrations**

  Sometimes a teacher may need to illustrate a particular technique or process to a group or an individual through simple demonstrations, rather than using prolonged and complex verbal descriptions of how to carry out a task. Demonstration demands observers to watch attentively, and enough time should be allowed for this. Other than giving personal demonstrations, teachers can invite students to demonstrate a skill, which is a good opportunity for them to show their capabilities.

- **Reading to learn**

  In DAT, structured activities can be designed to enable students to develop their reading to learn skills. A variety of learning materials are available, e.g. books, slides, video and multi-media. Students are encouraged to get access to information and become more responsible for their own learning.

Possible reading to learn activities
• During the research process: collect and read publications from various sources and compile information to inform the research; • Self-directed study: read instruction manuals for operating domestic appliances; and • Project on the impact of technology and design on society: broaden students' perspectives by reading and exploring the history of technology, good design, technology innovation, enterprise strategy and product analysis, etc.

- **Enterprise activities**

  Students' learning will be enhanced when they are able to explore and implement a technological solution in response to a challenge that is directly relevant to them. For example, students are encouraged to link technology and design to enterprise activities in which they tackle the development, manufacture and sale of a product in a business-like way. They can establish a market opportunity, design and make a product to meet that need, consider the distribution and sales, decide on an appropriate price, and evaluate how effective they have been.

4.4 Interaction

Both teachers and students have roles to play in ensuring that they interact effectively in promoting learning. Their roles change according to the objectives of different activities, but the focus should always be on helping students to understand and express themselves, so that they become independent thinkers and self-directed learners through the study of DAT.

4.4.1 Roles of students

Students are expected to take up more responsibility for their studies, as effective learning depends on how well students constructing their own knowledge. Meaning is constructed by individuals through experience, and through discussion about the experience. Thus learning should not only involve knowledge-acquisition but also meaningful interaction between teachers and students, and among students. Students need to resolve confusions, explore what they know and don't know through discussion, and they need to try out their ideas and obtain feedback, so that they can refine them.

4.4.2 Roles of teachers

Teachers should encourage students to construct their knowledge through active dialogue with them. They should ask open-ended questions through which students are encouraged to think for themselves and generate new hypotheses. Teachers need to create an accepting culture in classrooms where nobody's ideas are ignored or criticised, but where everyone's ideas can be listened to, respected and sharpened up through effective dialogue.

4.4.3 Collaborative learning

Teachers are encouraged to use a collaborative pedagogy involving discussion, debate and/or group work, in which students learn together towards a common goal.

Learning activities in technology provide many opportunities for group work in which students learn to relate to each other and work together. Many design and technological tasks in DAT demand a high level of negotiation, collaboration and respect for the ideas of others. Stronger forms of collaboration can be achieved when students are working to reach team goals, and perhaps even cooperating with partners outside the school.

Effective group work depends on a shared understanding among students. It is cooperative in the sense that no one in the group is focusing on his/her personal interests: it is not about competing with each other but about using a range of thoughts, experiences and resources available to deepen understanding, sharpen judgments and extend knowledge among members of the group.

Example of group work

A class is divided into groups with each group taking the role of a design company. The groups can all be given the same task – for example, designing a toy suitable for children aged 3–8 years, and each design company is asked to submit proposals, as would happen in real life. The groups can all work on the same task, and with the same constraints and considerations, but have freedom to develop their own designs. Each group presents and justifies its proposals, with the rest of the class acting as the customers and asking questions. There can then be a final evaluation of all the proposals, not only in terms of their aesthetic appeal but also how safe they are and how well they match the constraints and considerations identified.

4.5 Learning Communities

In a learning community, students and teachers join together to form a partnership and provide mutual support to each other in learning. Unlike the traditional classroom which is controlled by teachers, students play an important role in the community.

A learning community increases learners' involvement and motivation and fosters a strong sense of membership, as teachers and students become partners/joint investigators in the process of developing knowledge. Such a community of learners also enables students to develop their capacity for being responsible for their own learning and caring about the learning of their peers.

Learning communities require teachers, students, and sometimes other professionals in the field to collaborate in a variety of ways. A teacher may plan activities that allow students with different interests to participate, and cultivate an environment in which all participants share their experience and knowledge. Members of a learning community may differ in many respects, including their learning styles and abilities and the roles they play, and their share of the workload may vary in different tasks.

4.5.1 Learning outside the classroom

Life-wide learning opportunities should be provided to widen the exposure of students to the design and technological world. Studying the DAT curriculum becomes more purposeful if people from industry or related disciplines, such as the design or engineering fields, can be involved. This gives students opportunities to talk to designers or engineers directly, and allows them to appreciate how schoolwork is related to industry. This kind of learning experience enhances their motivation and provides them with up-to-date knowledge.

Linking schools and industry not only enhances students' understanding of industry and the workplace, but also enriches their learning by making it more relevant to their lives. Examples of such learning experience include visits and field studies on local and Pearl River Delta industries, technology competitions, seminars, and exhibitions. School-industry links can take the following forms:

- **Visits**

  Industrial visits enable students to see and develop an understanding of the manufacturing process, how the various sub-sections link together, and the importance of costing and quality assurance. A longer duration of the visit for students to watch the staff's work helps students to see how the staff within a company interact with each other.

- **Workplace attachments**

  Workplace attachments focus on specific aspects, for example on quality control or batch production. They provide students with a general overview of the manufacturing process; and students can work in groups to visit different parts of a company, or even different companies, and report their findings to the whole class.

- **Guest speakers**

  Professionals in the field can be invited to deliver talks or discuss contemporary issues with the students – for example, on the role of design, product development, marketing, costing, quality assurance or production methods.

Possible learning task outside the classroom

Find out what kinds of local industries are located in Hong Kong. Consider which of them may be relevant to the topics that you are going to teach, and consider what the benefits of developing links with these companies would be.

4.5.2 Information and Communication Technology (ICT) and learning communities

The Internet also provides a very effective means to facilitate interaction and support the building of learning communities among teachers and students, particularly since many youngsters in Hong Kong are already very familiar with communicating and networking through, for example, email, web-based instant messages and web journals. There are very promising possibilities in such technology for developing effective learning communities in DAT. However, the technology in itself will not bring this about. Teachers and students need to have shared goals and make quality inputs so that their interaction helps to achieve the goals of the learning community.

4.6 Catering for Learner Diversity

Students vary greatly in their learning styles and abilities. Catering for learner diversity can present a considerable challenge to teachers when determining the appropriate level of subject content and the most suitable methodologies for learning and teaching.

4.6.1 Curriculum adaptation

Teachers may cater for learner diversity by adapting the school curriculum to suit the specific needs and interests of their students. Adapting the curriculum can mean, among other things, trimming it down or making additions to it, or both. The teacher needs to employ his/her subject knowledge, professional skills and understanding of the learners to select and use appropriate methods to help them work towards the learning targets and objectives.

The DAT curriculum is not structured in a linear form and it need not be taught in a step-by-step fashion. In this regard, teachers have the flexibility to structure appropriate, achievable, but challenging activities to cater for students of varying ability. Students are encouraged to accumulate evidence of what and how they have learned, for example, by collecting the different designs of a product in the form of a design portfolio; and teachers can provide students with authentic 'hands-on' learning experiences and reinforce the importance of both manipulative and problem-solving skills, so that students with a practical orientation to learning can find their own way to perform well. Teachers can also encourage group work in design projects so that students with different personal characteristics, such as 'thinkers' and 'doers', can learn to support each other in completing the tasks through collaboration.

Teachers may also need to devise short and achievable activities with particular emphases to enable all students to achieve some success in their studies and perform to the best of their ability. Learner diversity can be accommodated to some degree through setting up a pleasurable learning environment and through flexible use of time, space and resources, as well as through adjusting content, strategies and modes of assessment.

4.6.2 Suggestions for handling various needs

The following are some suggested ways of catering for students' varied needs:

- Equal opportunities should be given for all students to gain essential learning experiences from activities inside and outside the classroom. Teachers are also encouraged to set some assignments which appeal to the interests of both male and female students;
- Gifted students can be provided with design project and other assignments that are more challenging than the regular ones. As individualising instruction for such students will help to keep them engaged, teachers may consider assigning mentors to gifted students to encourage them to undertake extra learning experiences in and outside school;
- In catering for the educational needs of students of lower ability, teachers might set less demanding tasks encompassing smaller steps in learning, to assist them to complete them successfully;
- For students with learning and emotional disabilities, the following strategies can be considered:
  - Provide a place in the classroom / a special room for practical learning activities for 'time-out' when things are not progressing well; and
  - Use behaviour and homework checklists to communicate with parents.
- To overcome any potential barriers to learning in DAT, some students may require:
  - alternative or adapted activities or specific support to overcome their disabilities in certain practical activities (e.g. non-visual communication, jigs to aid cutting, specialist ICT software, and more time to complete the range of work); and
  - adaptations in school-based assessment tasks.

Chapter 5 Assessment

This chapter discusses the role of assessment in DAT learning and teaching, the principles that should guide assessment of the subject and the need for both formative and summative assessment. It also provides guidance on internal assessment and details regarding the public assessment of DAT. Finally, information is given on how standards are established and maintained, and how results are reported with reference to these standards. General guidance on assessment can be found in the *Senior Secondary Curriculum Guide* (SSCG) (CDC, 2009).

5.1 The Roles of Assessment

Assessment is the practice of collecting evidence of student learning. It is a vital and integral part of classroom instruction, and serves several purposes and audiences.

First and foremost, it gives feedback to students, teachers, schools and parents on the effectiveness of teaching and on students' strengths and weaknesses in learning.

Second, it provides information to schools, school systems, government, tertiary institutions and employers to enable them to monitor standards and to facilitate selection decisions.

The most important role of assessment is in promoting learning and monitoring students' progress. However, in the senior secondary years, the more public roles of assessment for certification and selection come to the fore. Inevitably, these imply high-stakes uses of assessment since the results are typically employed to make critical decisions about individuals.

The Hong Kong Diploma of Secondary Education (HKDSE) provides a common end-of-school credential that gives access to university study, work, and further education and training. It summarises student performance in the four core subjects and in various elective subjects, including both discipline-oriented subjects (including DAT) and the new ApL courses. It needs to be interpreted in conjunction with other information about students provided in the Student Learning Profile.

5.2 Formative and Summative Assessment

It is useful to distinguish between the two main purposes of assessment, namely "assessment *for* learning" and "assessment *of* learning".

"Assessment *for* learning" is concerned with obtaining feedback on learning and teaching and utilising this to make learning more effective and to make any necessary changes to teaching strategies. We refer to this kind of assessment as "formative assessment" because it is all about forming or shaping learning and teaching. Formative assessment should take place on a daily basis and typically involves close attention to small "chunks" of learning.

"Assessment *of* learning" is concerned with determining progress in learning, and is referred to as "summative" assessment, because it is all about summarising how much learning has taken place. Summative assessment is normally undertaken at the conclusion of a significant period of instruction (e.g. at the end of the year, or of a key stage of schooling) and reviews much larger "chunks" of learning.

In practice, a sharp distinction cannot always be made between formative and summative assessment, because the same assessment can in some circumstances serve both formative and summative purposes. Teachers can refer to the SSCG for further discussion of formative and summative assessment.

Formative assessment should also be distinguished from continuous assessment. The former refers to the provision of feedback to improve learning and teaching based on formal or informal assessment of student performance, while the latter refers to the assessment of students' on-going work and may involve no provision of feedback that helps to promote better learning and teaching. For example, accumulating results in class tests carried out on a weekly basis, without giving students constructive feedback, may neither be effective formative assessment nor meaningful summative assessment.

There are good educational reasons why formative assessment to support assessment *for* learning should be given more attention and accorded a higher status than summative assessment, on which schools tended to place a greater emphasis in the past. There is research evidence indicating that formative assessment is beneficial when used for refining instructional decision-making in teaching and generating feedback to improve learning. For this reason, the CDC report *Learning to Learn – The Way Forward in Curriculum Development* (CDC, 2001) recommended that there should be a change in assessment practices, with schools placing due emphasis on formative assessment to make assessment *for* learning an integral part of classroom teaching.

It is recognised, however, that the primary purpose of public assessment, which includes both external public examinations and moderated school-based assessments, is to provide summative assessments of the learning of each student. While it is desirable that students are exposed to SBA tasks in a low-stakes context and benefit from practice and experience with the tasks (i.e. for formative assessment purposes) without penalty, similar tasks will need to be administered as part of the public assessment to generate marks to summarise the learning of students (i.e. for summative assessment purposes).

Another distinction to be made is between internal assessment and public assessment. Internal assessment refers to the assessment practices that teachers and schools employ as part of the ongoing learning and teaching process during the three years of senior secondary studies. In contrast, public assessment refers to the assessment conducted as part of the assessment processes in place for all schools. Within the context of the HKDSE, this means both the external public examinations and the moderated school-based assessments (SBA) conducted or supervised by the HKEAA. On balance, internal assessment should be more formative, whereas public assessment tends to be more summative. Nevertheless, this need not be seen as a simple dichotomy. The inclusion of SBA in public assessment is an attempt to enhance formative assessment or assessment *for* learning within the context of the HKDSE.

5.3 Assessment objectives

The assessment objectives for DAT are closely aligned with the curriculum framework and the broad learning outcomes presented in earlier chapters.

The learning objectives to be assessed in DAT are listed below:

1. to apply research, graphical communication and information-processing skills to the design process;
2. to respond to identified needs, wants and opportunities for technological products and processes, while being aware of the impact of technology and design on society;
3. to use the design process to develop design solutions to student-generated design problems in a range of contexts;
4. to select and use appropriate technology and relevant resources for designing, manufacturing and marketing a product; and
5. to demonstrate appropriate design decisions based on knowledge and understanding of design practices and relevant technological systems and processes.

5.4 Internal Assessment

This section presents the guiding principles that can be used as the basis for designing internal assessment and some common assessment practices for DAT for use in schools. Some of these principles are common for both internal and public assessment.

5.4.1 Guiding principles

Internal assessment practices should be aligned with curriculum planning, teaching progression, student abilities and the school context. The information collected will help to motivate, promote and monitor student learning, and will also help teachers to find ways of promoting more effective learning and teaching.

(a) Alignment with the learning objectives

A wide range of assessment practices should be used to assess the achievement of different learning objectives for whole-person development. These include case studies, design projects, technological explorations, fieldwork and portfolios. The weighting given to different areas in assessment should be discussed and agreed among teachers. The assessment purposes and criteria should also be discussed and agreed and then made known to students, so that they can have a full understanding of what is expected of them.

(b) Catering for the full range of student ability

Assessment at different levels of difficulty and in diverse modes should be used to cater for students with different aptitudes and abilities. This helps to ensure that the more able students are challenged to develop their full potential, and that the less able ones are encouraged to sustain their interest and succeed in learning.

(c) Tracking progress over time

As internal assessment should not be a one-off exercise, schools are encouraged to use practices that can track learning progress over time (e.g. portfolios). Assessment practices of this kind allow students to set their own incremental targets and manage their own pace of learning, which will have a positive impact on their commitment to learning.

(d) Timely and encouraging feedback

Teachers should provide timely and encouraging feedback through a variety of means, such as constructive verbal comments during classroom activities and written remarks on assignments, together with indications of where improvements could be made. Such feedback helps students to sustain their momentum in learning, and to identify their strengths and weaknesses.

(e) Making reference to the school's context

As learning is more meaningful when the content or process is linked to a setting which is familiar to students, schools are encouraged to design some assessment tasks that make reference to the school's own context (e.g. its location, relationship with the community, and mission).

(f) Making reference to current progress in student learning

Internal assessment tasks should be designed with reference to students' current progress, as this helps to overcome obstacles that may have a cumulative negative impact on learning. Teachers should be mindful in particular of concepts and skills which form the basis for further development in learning.

(g) Peer and self-assessment

In addition to giving feedback, teachers should also provide opportunities for peer assessment and self-assessment in student learning. The former enables students to learn among themselves, and the latter promotes reflective thinking which is vital for students' lifelong learning.

(h) Appropriate use of assessment information to provide feedback

Internal assessment provides a rich source of data of providing evidence-based feedback on learning in a formative manner.

5.4.2 Internal assessment practices

A range of assessment practices, such as case studies of innovations, "hands-on" technology explorations and large and small-scale design projects suited to the DAT should be used to promote the attainment of the various learning outcomes. However, teachers should note that these practices should be an integral part of learning and teaching, not "add-on" activities.

- **Case studies**

  In assessment, case studies can reveal:
  - analytical and critical thinking skills;
  - understanding of emerging technology; and
  - social, technological and entrepreneurship awareness.

- **Technology exploration task**

  In technological exploration assessment tasks students demonstrate a variety of 'hands-on' practical, experimental and task-based skills.

- **Projects**

  A project is any piece of extended work from which the constraints of lesson time have been largely removed. Asking students to carry out a design project provides evidence of students' ability to apply technological knowledge and generate ideas and solutions. Teachers may wish to draw the following steps in the process to students' attention:
  - clarifying the problem of design task;
  - establishing a framework for design;
  - finding out and selecting technologies and resources;
  - proposing solutions; and
  - presenting ideas.

- **Fieldwork**

  Fieldwork has many applications in different subjects and usually calls for keen observation, mastery of concepts and skills, and accurate recording. Fieldwork can often contribute significantly to establishing good relations between a school and its community. Also, the results of fieldwork can be very rewarding for students, both in learning the subject-matter and enhancing their social development.

- **Portfolios**

  This is a representative collection of students' work done during the course of study, e.g. design folders, artefacts, journals, and case study and fieldwork reports. Students will be asked to display their own favourite pieces of work from the year for assessment.

5.5 Public Assessment

5.5.1 Guiding principles

Some principles guiding public assessment are outlined below for teachers' reference.

(a) Alignment with the curriculum

The outcomes that are assessed and examined through the HKDSE should be aligned with the aims, objectives and intended learning outcomes of the SS curriculum. To enhance the validity of public assessment, the assessment procedures should address the range of valued learning outcomes, not just those that are assessable through external written examinations. These include design activities and the application of technology in daily living, case studies, design projects and fieldwork.

(b) Fairness, objectivity and reliability

Students should be assessed in ways that are fair and are not biased against particular groups of students. A characteristic of fair assessment is that it is objective and under the control of an independent examining authority that is impartial and open to public scrutiny. Fairness also implies that assessments provide a reliable measure of each student's performance in a given subject so that, if they were to be repeated, very similar results would be obtained.

DAT will adopt the use of external moderators to moderate students' project work to achieve a fair, professional and reliable assessment.

(c) Inclusiveness

The assessments and examinations in the HKDSE need to accommodate the full spectrum of student aptitude and ability.

DAT is designed to be suitable for students with different interests and abilities, and includes, for example, the study of daily-life applications and the impact of technology.

(d) Standards-referencing

The reporting system is 'standards-referenced', i.e. student performance is matched against standards, which indicate what students have to know and be able to do to merit a certain level of performance.

A sample set of students' work is provided to teachers for reference.

(e) Informativeness

The HKDSE qualification and the associated assessment and examinations system provide useful information to all parties. Firstly, it provides feedback to students on their performance and to teachers and schools on the quality of the teaching provided. Secondly, it communicates to parents, tertiary institutions, employers and the public at large what it is that students know and are able to do, in terms of how their performance matches the standards. Thirdly, it facilitates selection decisions that are fair and defensible.

5.5.2 Assessment design

The table below shows the assessment design of the subject with effect from the 2016 HKDSE Examination. The assessment design is subject to continual refinement in the light of feedback from live examinations. Full details are provided in the Regulations and Assessment Frameworks for the year of the examination and other supplementary documents, which are available on the HKEAA website (www.hkeaa.edu.hk/en/hkdse/assessment/assessment_framework/).

Component	Part		Weighting	Duration
Public Examination	Paper 1	Compulsory Part	30%	2 hours
	Paper 2	Elective Part – Each candidate is required to choose any two of the following five modules: 2A: Automation 2B: Creative Digital Media 2C: Design Implementation and Material Processing 2D: Electronics 2E: Visualisation and CAD Modelling	30%	2 hours
School-based Assessment (SBA)	Design Project		40%	

5.5.3 Public examinations

The overall aim of the public examination is to assess candidates' abilities to demonstrate their knowledge and understanding in different areas of technology and to apply this to their daily lives.

Different types of items are used to assess students' performance in a broad range of skills and abilities. The types of items include short questions, structured data-response questions and essays. Schools may refer to the live examinations papers regarding the format of the examination and the standards at which the questions are pitched.

5.5.4 School-based assessment (SBA)

In the context of public assessment, SBA refers to assessments administered in schools and marked by the students' own teachers. The primary rationale for SBA in DAT is to enhance the validity of the assessment by extending it to include the assessment of students' skills in the following areas:

- Identification and analysis of design problems
- Collection of data
- Conducting research and investigations
- Generation and development of design ideas
- Making proposed final solutions
- Presentation of solutions with suitable media
- Evaluation of final solutions.

More generally, SBA reduces dependence on the results of one-off examinations, which may not always provide the most reliable indication of the actual abilities of candidates. Assessments based on student performance over an extended period of time and developed by those who know the students best – their subject teachers – provides a more *reliable* assessment of each student.

Another reason for SBA is to promote a *positive* "*backwash effect*" *on students, teachers and school staff*. Within DAT, SBA can serve to motivate students by requiring them to engage in meaningful activities; and for teachers, it can reinforce curriculum aims and good teaching practice, and provide structure and significance to an activity they are in any case involved in on a daily basis, namely assessing their own students.

It should be noted that SBA is not an "add-on" element in the curriculum. The modes of SBA above are normal in-class and out-of-class activities suggested in the curriculum. The requirement to implement SBA has taken into consideration the wide range of student ability, and efforts have been made to avoid unduly increasing the workload of both teachers and students. Detailed information on the requirements and implementation of SBA and samples of assessment tasks are provided to teachers by the HKEAA.

5.5.5 Standards and reporting of results

Standards-referenced reporting is adopted for the HKDSE. What this means is that candidates' levels of performance are reported with reference to a set of standards as defined by cut scores on the mark scale for a given subject. Standards referencing relates to the way in which results are reported and does not involve any changes in how teachers or examiners mark student work. The set of standards for a given subject can be represented diagrammatically as shown in Figure 5.1.

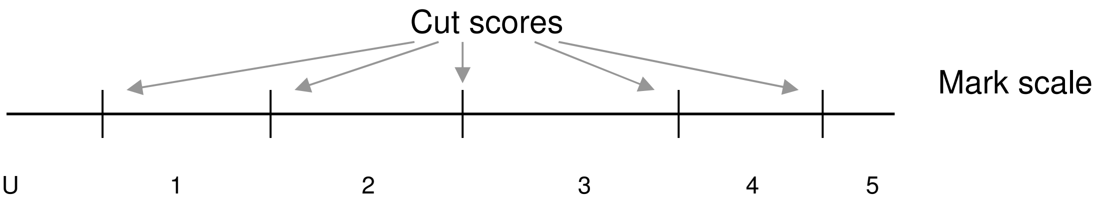


Figure 5.1 *Defining levels of performance via cut scores on the mark scale for a given subject*

Within the context of the HKDSE there are five cut scores, which are used to distinguish five levels of performance (1–5), with 5 being the highest. A performance below the cut score for Level 1 is labelled as 'Unclassified' (U).

For each of the five levels, a set of written descriptors has been developed to describe what the typical candidate performing at this level is able to do. The principle behind these descriptors is that they describe what typical candidates *can* do, not what they *cannot* do. In other words, they describe performance in positive rather than negative terms. These descriptors represent 'on-average' statements and may not apply precisely to individuals, whose performance within a subject may be variable and span two or more levels. Samples of students' work at various levels of attainment are provided to illustrate the standards expected of them. These samples, when used together with the grade descriptors, will clarify the standards expected at the various levels of attainment.

In setting standards for the HKDSE, Levels 4 and 5 are set with reference to the standards achieved by students awarded grades A–D in the HKALE. It needs to be stressed, however, that the intention is that the standards will remain constant over time – not the percentages awarded different levels, as these are free to vary in line with variations in overall student performance. Referencing Levels 4 and 5 to the standards associated with the old grades A–D is important for ensuring a degree of continuity with past practice, for facilitating tertiary selection and for maintaining international recognition.

The overall level awarded to each candidate is made up of results in both the public examination and the SBA. SBA results for DAT are moderated based on the judgment of panels of external moderators, through the inspection of samples of students' work.

To provide finer discrimination for selection purposes, the Level 5 candidates with the best performance have their results annotated with the symbols ** and the next top group with the symbol *. The HKDSE certificate itself records the Level awarded to each candidate.

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Chapter 6 Learning and Teaching Resources

This chapter discusses the importance of selecting and making effective use of learning and teaching resources, including textbooks, to enhance student learning. Schools need to select, adapt and, where appropriate, develop the relevant resources to support student learning.

6.1 Purpose and Function of Learning and Teaching Resources

The purpose of learning and teaching resources is to provide a basis for students' learning experiences. Learning resources include not only textbooks, workbooks and audio-visual teaching aids produced by EDB or other organisations but also web-based learning materials, IT software, the Internet, the media, libraries, resources in the natural environment, and people. All of these should be drawn upon to help students broaden their learning experiences and meet their varied learning needs. If used effectively, they will help students to consolidate what they have learned, extend and construct knowledge for themselves, and lay a solid foundation for lifelong learning.

Apart from textbooks, it is important for schools to develop their own school-based learning and teaching resources according to the needs, interests and abilities of their students. Textbooks and school-based learning and teaching materials can complement each other in supporting the teaching and learning of DAT.

6.2 Guiding Principles

The basic criteria for the selection of learning and teaching resources are that:

- the nature and content of the resources should be in line with the aims of the curriculum and facilitate the development of the knowledge, skills, values and attitudes it promotes. They should also contain core elements of the curriculum.
- they should provide access to knowledge, as well as scaffolding, to extend what students have learned and promote independent learning.
- they should arouse students' interest and engage them actively in learning activities.
- they should present information accurately and effectively.
- the language used should be of a good standard.
- they should cater for students' individual differences by providing learning activities at different levels of difficulty.
- they should support the pedagogy proposed in the curriculum and provide students with a variety of different learning experiences.

6.3 Types of Resources

The learning approaches and strategies advocated for DAT require a wide range of learning and teaching resources to support students' learning.

6.3.1 Textbooks and teaching packages

Textbooks can be an important source of information to support the teaching of DAT. In case textbooks are unavailable or unsuitable for any reason, EDB intends to develop relevant learning and teaching packages – to which tertiary institutions and professional organisations will be invited to contribute. Also, a wide range of resources related to DAT is currently available on the Web. Some examples of Web resources which support the curriculum are given in Appendix 7.

6.3.2 Other resources

Teachers should be flexible and utilise a range of materials, some of which can be used to promote 'Reading to Learn'. Such resources include:

- Printed materials such as reference books, newspapers, magazines and journals, and most of them are easily accessible in libraries;
- Multi-media resources such as films, educational software, and simulation programmes;
- Internet resources such as the websites on related technological developments; and
- Community resources such as public libraries, exhibition centres and museums.

Learning resources are also available from various sources such as tertiary institutions, trade and industrial associations, professional bodies, private corporations, and other schools and teachers. Schools are advised to adopt a wide variety of suitable resources from sources such as successful school-based curriculum projects, the media and relevant learning packages.

6.3.3 The Internet and other technologies

The massive increase in the quantity of information available on the Internet has led to new approaches to learning and teaching. Teachers need to help students to search for information and to work on it in order to turn it into knowledge.

IT promotes learning in DAT by:

- providing audio-visual aids for understanding difficult concepts;
- providing access to information from a wide variety of sources and handling large quantities of information;
- allowing students to work at their own pace, including the use of specially designed software;
- offering Web-based interactive learning;

- enhancing collaboration between learners and teachers through networking; and
- producing quality formal presentations.

The use of IT tools helps students to enhance the quality of their work in technology and design. The following points highlight areas in which IT can be applied in learning and teaching DAT:

- Designing – Applications such as CAD software enable students to explore their design ideas, in both initial design expression and more formal design drawing;
- Modelling – Applications such as simulation software and Rapid Prototyping can help students to explore design possibilities and see how they might work; and
- Manufacturing – Applications such as CAM can be used by students to enhance the quality of their productions.

6.3.4 Community resources

A spirit of partnership is necessary among the many parties who can contribute in different ways to helping our students learn effectively. The EDB will continue to establish close partnerships with different stakeholders in the education sector, including universities, teacher training institutions, professional bodies, academics and experts in relevant disciplines, so that community resources can be used to assist the delivery of the DAT curriculum. Some of the relevant organisations are listed in Appendix 8 for teachers' reference.

- **Parents**

  When parents are well informed about their youngsters' schools, they are likely to feel more responsible for encouraging their youngsters outside the classroom, and are more supportive of the teaching staff. Parents also play an important role in helping their youngsters to choose DAT as one of the electives in the senior secondary curriculum. It can be useful to give parents information about what is involved in studying the subject through systematically planned events – such as exhibitions of students' work, talks on careers and further study, and school visits. Schools can also identify parents who are working in areas related to industry, technology or design and invite them to share their experience with students.

- **Employer and industry links**

  A mutually beneficial partnership can be developed with employers and industry, in which, for example, they provide site visits, work placements, a source for research and sponsorship.

- **Alumni and old students**

  Schools should establish close links with alumni who studied DAT to use their experience and support. For example, those working in relevant fields can be involved in promoting the subject and advising students. Success stories of ex-students can be particularly inspiring.

- **Tertiary institutions and professional bodies**

  Tertiary institutions, trade and industrial associations, and professional bodies are valuable resources for supporting the implementation of DAT. Schools can ask for support and advice from such organisations in developing learning and teaching resources. With their experience, professional practitioners are potential mentors for students.

- **Teachers' network**

  A teachers' network – formed, for example, as part of a teacher association – can provide a platform for experienced DAT teachers to share their experience with others on a range of issues, such as good coursework design, effective instructional approaches, lesson preparation, guiding students' projects and the development of rubrics for assessment.

6.3.5 Curriculum resources directory service

To assist schools in the management of curriculum change, the EDB has provided them with a one-stop curriculum resources directory service at www.edb.gov.hk/cr. The directory provides a central pool of ready-to-use learning and teaching resources and useful references developed by the EDB and other parties.

6.4 Flexible Use of Learning and Teaching Resources

School-based learning and teaching resources should be specially prepared for students who have difficulty in understanding particular topics. Teachers can refer to the resources developed by the EDB and customise them to provide suitable learning tasks for less able students. Also, to fulfil the potential of gifted DAT students, extension activities should be provided in which they investigate topics of interest in depth outside the classroom (e.g. through compiling a different resource/reference list, or providing more Internet websites).

Some topics in DAT are more conceptual while others are more practical. This implies flexible grouping of students, so that more students can be grouped together in lessons using a direct lecturing approach, while smaller groups are used for tutorials and practical work.

6.5 Resource Management

Schools need to coordinate and maximise the use of special rooms, tools, teaching kits and IT resources for the successful implementation of the DAT curriculum.

6.5.1 Developing a school-based resource bank

A system should be developed to manage the vast amount of school-based resources and documents on the subject, such as DAT panel records, the curriculum and syllabuses, schemes of work, and teaching and assessment records. It is important that there is shared ownership of all the documentation and resources. Through collaboration and continuous refinement, the resource bank can provide comprehensive support for a variety of learning and teaching activities.

6.5.2 Sharing resources

A culture of sharing is the key to effective knowledge management. Schools should make arrangements for:

- teachers and students to share learning and teaching resources through the Intranet or other means within the school;
- teachers to form professional development groups for the exchange of experience.

6.5.3 Accessing resources

It is important for teachers to ensure that the DAT resources are accessible to students and used as effectively as possible to enable them to produce the highest standards of work possible. Students should be provided with opportunities to work in a number of equipment-based rooms to develop particular skills, knowledge and understanding in technology and design.

When designing, students need to make important decisions about the materials and components they propose to use, and to justify their choices. To support them in doing so, teachers need to ensure that, wherever possible, a range of materials and components are available or that students have access to the necessary information.

Access to IT equipment will depend partly on the school's IT policy and practice. Individual computers dedicated to specific tasks, such as CAD/CAM machines, or the use of a control interface with a working model or system may be needed. Computer rooms may also be used for whole-class teaching or information retrieval and analysis.

Students need to work in a safe and adequately supervised environment that complies with the Education Regulations. Schools are responsible for taking all the necessary precautions to maintain a safe learning environment in special rooms.

6.5.4 Storing resources

Storage space of an adequate size is needed for:

- materials and components;
- tools and equipment;
- students' work in progress;
- teachers' materials; and
- displays of stimulus materials and students' successful work.

6.5.5 Inventories of equipment

DAT panel chairpersons should maintain an inventory of equipment, so that teachers are fully aware of what is available for learning and teaching the subject.

Schools are advised to verify the stocks of equipment they have at least once a year.

6.5.6 Funding

To assist schools to implement the senior secondary curriculum, the EDB will continue to provide schools with funding and allow them greater flexibility in the use of resources to cater for their diverse needs. Schools are advised to refer to the relevant and latest circulars issued by the EDB from time to time.

Appendix 1

Example of a 'hands-on' practical task: laminated beams vs solid beams

Introduction

Construction projects often require beams to bridge long distances. Laminated wood structures are widely used in modern construction because of their strength and beauty.

Practical activity

Students are asked to manufacture laminated beams and test them against solid, sawed beams. During testing, students will discover how various glues may affect the strength of a finished product. They will also graph their results and draw conclusions based on the data gathered from the testing process.

Objectives

After completing this practical activity, students should be able to:

- explain how beams are used in construction;
- describe how laminated structural members differ from solid members;
- describe how laminated members affect the design process;
- test solid and laminated beams and draw conclusions based on the data gathered; and
- graph data gathered during material tests.

Procedures

(1) Build the test fixture.

(2) Divide the class into groups of two or three students.

(3) Distribute the materials needed for this activity to each group.

(4) Place the test specimen along the knife-edge and extend the ram till it reaches the specimen.

(5) Record the reading from the pressure gauge and the height at the bottom of the specimen on the laboratory data sheet.

(6) At every 5mm of deflection, read the dial and record the pressure. Continue the test until the beam breaks.

(7) Repeat for all the laminated beams and solid beams.

(8) Fill in all the blanks on the data form.

(9) On graph paper, plot deflection on the X-axis and load on the Y-axis.

(10) Calculate the modulus of elasticity and fibre stress.

Appendix 2

An example of thematic learning: designing and producing a souvenir

Background and context

The production and distribution of souvenirs can be a viable promotional strategy for an organisation. Working in teams, students develop a concept to be put forward for the consideration of various organisations. Organisations in the local community that might be interested in using souvenirs as a marketing strategy can be schools, local sporting clubs and local businesses.

The class decides on a list of the best people to approach and considers how they could be invited to become clients or partners in the concept, perhaps providing sponsorship for the venture. A marketing proposal is developed for use in approaching the potential partners. In the proposal, students must consider the '4Ps' of marketing, i.e. product, price, place and promotion.

Students are divided into groups and work cooperatively in the following activities:

1: Proposal and discussion

The class is divided into teams to brainstorm a list of organisations that might be interested in using souvenirs as a marketing item. The class as a whole decides on the best prospects and each group chooses several to contact; and they then discuss how the organisations should be approached about the concept and how the product should be defined.

2: Planning

Once they have established the souvenir concept, they develop a marketing plan, bearing in mind the '4Ps' and outlining the:

- objectives;
- target audience;
- promotional strategies;
- budget; and
- timeline.

3: Seeking partnerships

The organisations identified earlier are approached to discuss the proposal. They are provided with samples for their appraisal, and invited to make suggestions.

4: Budgeting

The students obtain quotations for the materials needed for producing the souvenirs, and formulate an appropriate budget plan.

5: Promotion and distribution

The students discuss any promotional strategies and distribution methods for the product suggested by the clients.

6: Develop a timeline

A timeline for task completion is developed, working backwards from the deadline set for distribution, and tasks are allocated to specific individuals or groups.

7: Implementation and monitoring

The students monitor progress against the timeline and budget for the production of the souvenir. The timeline and a running sheet of income and expenditure is put on a classroom wall, to keep all members of the class informed about the budget situation.

8: Evaluation

After the product has been completed, the class evaluates the outcomes of the project against the objectives that were set in the planning stage, and this should include feedback from the partners.

Examples of topics for case studies

Note:

- The teacher should introduce the case studies by integrating them into the teaching and learning activities as appropriate.
- Students should be provided with the topics that they need to cover in their case studies and work independently to complete the task.

Topics	Strategies/Activities
The impact of technology on society	• Discuss examples of current innovations and how they have improved an aspect of our everyday lives. • Investigate changing lifestyles and how this has influenced the ergonomics of design.
Ethical and environmental issues	• Discuss examples of environmental issues and product life-cycle changes due to changes in government regulations for the environment.
Factors that affect the success of an innovation	• Make notes on the factors that have contributed to the success or failure of innovations. • Identify the diversity of technologies available to companies to assist them in conveying their intended images. • Discuss why new designs to meet recyclability legislation often yield unexpected benefits.
The work of designers	• Investigate, report and define design practices by recalling the steps in the design process. • Identify a trend in design and technological activity and the issues arising from its development.
The influence of trends in society on design and production	• Select an item and identify the historical and cultural influences on the design and technological development of the product.
Quality, innovation and creativity	• Investigate the entrepreneurial strategic planning of one company. • Investigate the image of quality and the process of Total Quality Management in relation to how well a product meets end-use and consumer lifestyles.
The impact of emerging technologies	• Explain the role and application of copyright in relation to catering for technological improvements. • Discuss and make notes on the impact of emerging technologies on innovation.

Case Study I
Theme: materials, structure and mechanisms

Overall expectation

Students are expected to formulate a design brief and specifications from a need analysis. They need to select and use appropriate research methods to gather, interpret and report design information. The brief should include specifications related to social, economic and technological issues.

The case: Lantau link

The Lantau Link joins Hong Kong's commercial heart and the new international airport on Lantau Island by road and rail. It has two bridges and a high-level viaduct. The suspension bridge was designed and constructed by the British firm Mott MacDonald. It gives business people and tourists quick, reliable access to the airport.

1 Design criteria

The bridge had to have a six-lane highway, a two-lane covered highway, and two railway lines. The bridge designers had to develop a bridge in the face of many conflicting requirements. It had to be strong, stable and able to withstand typhoons, earthquakes, big temperature changes, rain and salty water, and collisions with ships. It also had to be high enough for large ships to pass underneath, yet low enough not to interfere with flight paths. And it had to look good!

2 An innovative design – the big idea

The brief for the bridge followed investigations into what would be most economical and reliable – a tunnel or a bridge. Mott MacDonald looked at two types of tunnel. One was an immersed tube, which involves building the tunnel in sections on shore, floating them out to sea, sinking them onto the seabed into a trench, and then pumping out the water. The second was a bored tunnel, which is dug underneath the seabed, like the Channel Tunnel. Looking at what the link had to do, the cost of building and maintenance, the disruption that would be caused to shipping and the impact on the environment, they decided that building a high-level bridge would be the most economical and flexible solution.

- 'The basic concept came from the accumulated knowledge of Mott's engineers who had been involved on the Severn and Forth suspension bridges. With the necessary experience and imagination, these engineers were able to conceive of a suspension bridge that would be able to cope with the typhoon winds of the Far East and carry a road and railway safely.'
- 'One has to have a feeling for structural behaviour and hence be aware of what is going to work. The process is very much the development from concept to

preliminary design on to detailed design, with investigative studies on such things as soil, aerodynamics and vibration being carried out in parallel. We worked in collaboration from the early stages with an architect to ensure that the structural forms were developed with good aesthetic qualities.'

3 Juggling with problems

The Lantau Link design team had to solve many problems.

'Our brief was to develop a detailed design for a high-level bridge crossing of the two sea channels between the mainland and Lantau island where the airport was being built.'

The bridge had to meet a difficult performance specification. It had to:

- carry passengers and freight on a six-lane highway in normal conditions, and on a sheltered two-lane highway when the weather is extreme;
- carry passengers comfortably in trains at speeds up to 135 km/hr on twin rail tracks;
- withstand severe tropical storms – a typhoon there can produce three second gusts of up to 160 km/hr for the road and 180 km/hr on the railway;
- withstand temperature changes of plus or minus 230℃;
- withstand earthquakes, and the impact of a large ship;
- have at least 60m clearance below the bridges for ocean-going ships to pass beneath;
- keep the overall height below 206m so that planes could take off from and land safely at the airport;
- be durable to withstand the effects of rain and salt water; and
- look beautiful – this is a prestige project of international importance.

The final solution successfully met all these requirements.

4 Costs and benefits

The new airport was needed to allow for more and more people and goods to come in and out of Hong Kong. The Lantau Link makes life easier for all sorts of people, and allows business to flourish. The Airport Express Link and Lantau Link are expected to carry around 250,000 passengers a day.

Activities

Students are divided into groups and work cooperatively in the following activities:

1 Research

- Find out the details of the Lantau Link.
- Find out about suspension bridges.
- Make a simple sketch of a suspension bridge, and name the most important parts. Use notes to explain how each part helps to support the bridge.
- Find out about the properties of high tensile steel and how it is different from other forms of steel. Use the findings to explain why the designers chose this material for the cables.

Each member of the group is assigned different tasks for which they are responsible.

2 Questions

- Look back on something you have designed and made. How did you set about it? Did you work from concept to preliminary design to detailed design? How did your investigations help you to come to sound design decisions? Remember – not all designers work in the same way!
- Discuss this with others in your class. Every innovation benefits some people, but usually at a cost to some others. Draw up a list of all those who might be affected by the building and operation of the bridge. Use this list to find out if there are any 'losers' from the Lantau Link.

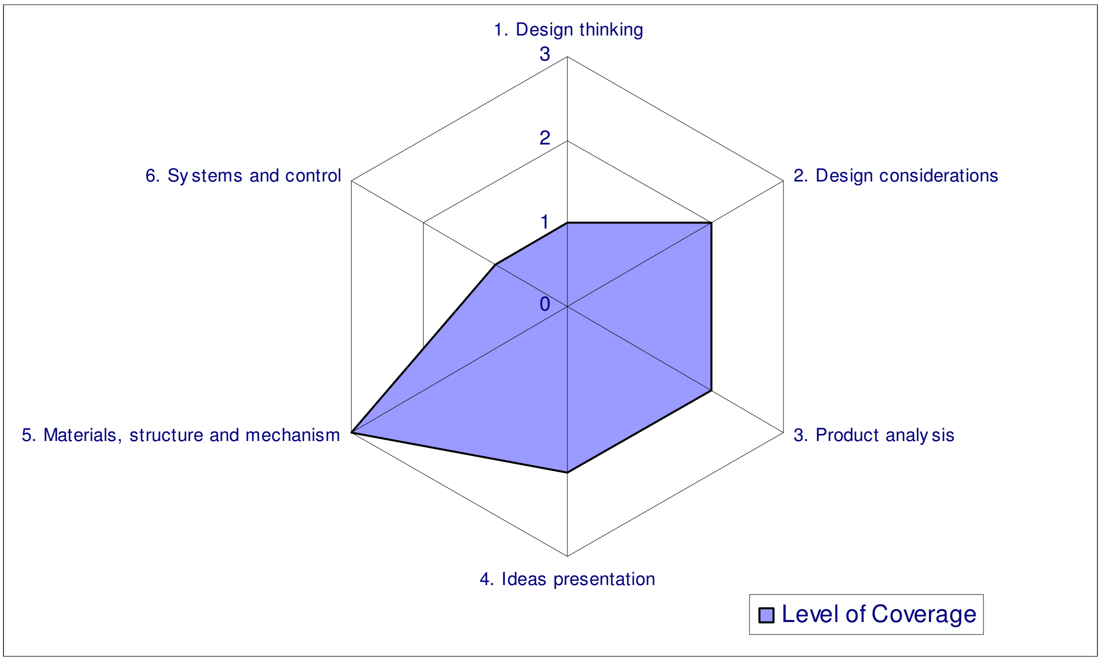
  Students are required to present their findings and analysis in the group through presentations, debates or other forms of dialogue.

3 Research

- Look for other websites to find out about bridges designed elsewhere.

(Source: *Resource Pack from the Design Council)*

What to learn?



Case study II
Theme: design thinking and innovative Ideas

Overall expectation

Students are expected to develop a flexible and creative view on how great ideas can be generated, developed and implemented through a relevant design process and the application of appropriate technology.

Expected learning outcomes

Students should be able to:

- develop design thinking skills by making use of relevant tools and methods such as concept mapping, brainstorming;
- understand the various factors involved in design, such as cultural, social and economic influences;
- analyse products from multiple perspectives;
- present ideas using verbal and graphical means;
- evaluate the materials, structure and mechanism of a Walkman; and
- describe briefly how the control system works in a Walkman.

The case: Walkman

Design thinking

Design consideration

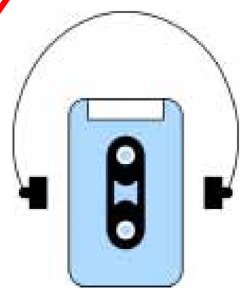
Akio Morita, the Chief Executive Officer (CEO) of Sony, often initiated new designs on the basis of his observation of everyday life. He noted the ingenious things people did in order to listen to music wherever they were: on the beach, in the park and whilst walking or jogging.

Product analysis

Material, structure and mechanism

Innovation

Sony had once before led the world in the development of the transistor radio. They replaced valves with transistors, thus enabling radios to be much smaller. **This innovation and the Walkman are perfect examples of advances in technology, materials and manufacturing bringing about changes in design**.



The technology for the Walkman already existed with the development of the integrated circuit (known as ICs or chips) and small-scale electric motors. Morita persuaded the engineers at Sony to improve the quality of sound and to leave out the recording function to save space, and **in 1979 the Sony Walkman was born**.

Ideas presentation

Systems and control

Entrepreneurship

Suggested follow-up activities

(1) Exercise on product analysis: keep an open mind - free your minds.
(2) Suggest ways to improve the product: work together as a team to solve problems.
(3) Whose life is it? Analyse the information collected.
(4) Observation exercise: in-depth interviewing and role-playing to establish what users really want from a product.
(5) Make your ideas happen:
    - Brainstorming: product ideas
    - Developing ideas: best and practical ideas
    - Rapid prototyping: cardboard/foam board, etc.

(Source: Resource Pack from the Design Museum)

Appendix 6

Examples of design project work

Design project 1: Educational toys

Toys play an important role in promoting children's mental and physical development.

Possible learning activities:

- Investigate the range, functions, attractiveness, constraints and promotion of educational toys currently available;
- Research successful cases of educational toys as commercial products;
- Identify gaps and design options for a new/redesigned product;
- Formulate management plans to meet the identified goals; and
- Design an educational toy and make two-dimensional and three-dimensional representations of the design solution.

Design project 2: Dream house

Intelligent building can provide a productive and cost-effective environment through optimising its basic elements, i.e. its structure, systems, services and management, and the inter-relationships among them.

Possible learning activities:

- Investigate the development of intelligent buildings (e.g. energy saving, automation, communication, comfort, health, maintenance, structural flexibility);
- Model a dream-house using the concept of intelligent building;
- Design, develop, test, produce and promote a new product/system for the dream-house;
- Prepare a patent application for the innovation; and
- Analyse the impact of intelligent building on modern life (e.g. safety and security, simple or sophisticated life, culture and human society).

Design project 3: Cooking facilities

People enjoy cooking when the cooking facilities are user-friendly.

Possible learning activities:

- Investigate a range of cooking facilities for use from home to industry and from indoors to outdoors;
- Conduct an analysis of a cooking facilities product of that has the potential for redesign;
- Specify the design requirements and model a solution;
- Develop a project plan for mass production of the product; and
- Evaluate the potential market value for the product.

Design project 4: Unmanned spaceship

China has great achievements in space technology. Imagine that an unmanned spaceship is going to be launched by China into unknown space.

Possible learning activities:

- Investigate the development of space technology and its impact;
- Explore the designs for a spaceship – shape and structure, environment, facilities in the spaceship cabin, communication and control, etc.;
- Develop new ideas for the design of a spaceship;
- Plan, specify, and produce a model or prototype for the new ideas identified; and
- Present a talk on the possibilities and solicit feedback from the audience.

Appendix 7

Web-based learning resources

1. The following web-based learning resources developed by the EDB are available on the Web:

   - Web-based course on design studies:
     (A) Design basics
     (B) Product design
     (C) Communication design

   - Web-based course on modern technology updates:
     (A) Automation and modern production techniques
     (B) Smart home and IT

   - Course materials on technological design

   - Course materials on visual communication

   - Other design/technology-related learning and teaching materials

2. Examples of case studies:

   - Design Council, United Kingdom
   - Design Museum, United Kingdom
   - Powerhouse Museum, Sydney, Australia

3. Other useful websites:

   - Journals
   - Encyclopedias
   - Libraries
   - Museums
   - 'How stuff works'
   - Web-based experiments/demonstrations
   - Professional organisations
     - Curriculum Corporation, Australia
     - International Technology Education Association, USA
     - The Design and Technology Association, United Kingdom

Appendix 8

List of local professional bodies and organisations

Some examples of local professional bodies and organisations relevant to DAT are suggested below. The lists are for reference only and are by no means exhaustive.

Professional organisations

- Hong Kong Designers Association
- Industrial Designers Society of Hong Kong
- The Hong Kong Institution of Engineers
- The Professional Validation Council of Hong Kong Industries

Government bureaux and departments

- Education Bureau
- Electrical and Mechanical Services Department
- Environmental Protection Department
- Hong Kong Science Museum
- Innovation and Technology Commission
- Intellectual Property Department
- Labour Department
- Leisure and Cultural Services Department – Museums
- Leisure and Cultural Services Department – Public Library Services

Government funded/founded organisations

- Consumer Council
- Inno Centre
- Hong Kong Applied Science and Technology Research Institute Company Limited
- Hong Kong Convention and Exhibition Centre
- Hong Kong Design Centre
- Hong Kong Education City
- Hong Kong Examinations and Assessment Authority
- Hong Kong Productivity Council
- Hong Kong Science and Technology Parks Corporation
- Hong Kong Trade Development Council
- Vocational Training Council

Industrial/technology organisations

- Federation of Hong Kong Industries
- Hong Kong Invention Association
- Hong Kong Young Industrialists Council
- The Chinese Manufacturers' Association of Hong Kong
- The Hong Kong Association for the Advancement of Science and Technology

Educational organisations

- Electronics Technology Education Association (HK)
- Hong Kong New Generation Cultural Association
- Hong Kong Robotic Olympic Association
- Hong Kong Technology Education Association

Tertiary institutions

- City University of Hong Kong
- Hong Kong Baptist University
- Hong Kong Institute of Vocational Education
- Lingnan University
- The Chinese University of Hong Kong
- The Hong Kong Institute of Education
- The Hong Kong Polytechnic University
- The Hong Kong University of Science and Technology
- The Open University of Hong Kong
- The University of Hong Kong

Glossary

Term	**Description**
Applied Learning (ApL, formerly known as Career-oriented Studies)	Applied Learning (ApL, formerly known as Career-oriented Studies) is an essential component of the senior secondary (SS) curriculum. ApL uses broad professional and vocational fields as the learning platform, developing students' foundation skills, thinking skills, people skills, values & attitudes and career-related competencies, to prepare them for further studies and / or for work as well as for lifelong learning. ApL courses complement 24 SS subjects, diversifying the senior secondary curriculum.
Assessment objectives	The outcomes of the curriculum to be assessed in the pubic assessment.
Co-construction	Different from the direct instruction and construction approaches to learning and teaching, the co-construction approach emphasises the class as a community of learners who contribute collectively to the creation of knowledge and the building of criteria for judging such knowledge.
Core subjects	Subjects recommended for all students to take at senior secondary level: Chinese Language, English Language, Mathematics and Liberal Studies.
Curriculum and Assessment (C&A) Guide	A guide prepared by the CDC-HKEAA Committee. It embraces curriculum aims / objectives / contents and learning outcomes, and assessment guidelines.
Design contexts	In DAT, students can explore a variety of design contexts such as personal life, the home, the school, recreation, the community, the environment, business and industry to find connections between technology, design and society.
Elective subjects	A total of 20 subjects in the proposed new system from which students may choose according to their interests, abilities and aptitudes.
Entrepreneurship	In the context of DAT, 'entrepreneurship' means searching for client-oriented and value-driven design, and developing enterprising attitudes such as initiative, risk-taking, responsibility, and adaptability.

Term	Description
Generic skills	Generic skills are skills, abilities and attributes which are fundamental in helping students to acquire, construct and apply knowledge. They are developed through the learning and teaching that take place in different subjects or key learning areas, and are transferable to different learning situations. Nine types of generic skills are identified in the Hong Kong school curriculum, i.e. collaboration skills, communication skills, creativity, critical thinking skills, information technology skills, numeracy skills, problem solving skills, self-management skills and study skills.
Hong Kong Diploma of Secondary Education (HKDSE)	The qualification to be awarded to students after completing the senior secondary curriculum and taking the public assessment.
Innovation	In the context of DAT, 'innovation' means developing creative ideas towards tangible solutions.
Internal assessment	This refers to the assessment activities that are conducted regularly in school to assess students' performance in learning. Internal assessment is an inseparable part of the learning and teaching process, and it aims to make learning more effective. With the information that internal assessment provides, teachers will be able to understand students' progress in learning, provide them with appropriate feedback and make any adjustments to the learning objectives and teaching strategies they deem necessary.
Key learning areas	Organisation of the school curriculum structured around fundamental concepts of major knowledge domains. It aims at providing a broad, balanced and coherent curriculum for all students in the essential learning experiences. The Hong Kong curriculum has eight KLAs, namely, Chinese Language Education, English Language Education, Mathematics Education, Personal, Social and Humanities Education, Science Education, Technology Education, Arts Education and Physical Education.
Knowledge construction	This refers to the process of learning in which learners are involved not only in acquiring new knowledge, but also in actively relating it to their prior knowledge and experience so as to create and form their own knowledge.
Learning community	A learning community refers to a group of people who have shared values and goals, and who work closely together to generate knowledge and create new ways of learning through active participation, collaboration and reflection. Such a learning community may involve not only students and teachers, but also parents and other parties in the community.

Term	Description
Learning outcomes	Learning outcomes refer to what learners should be able to do by the end of a particular stage of learning. Learning outcomes are developed based on the learning targets and objectives of the curriculum for the purpose of evaluating learning effectiveness. Learning outcomes also describe the levels of performance that learners should attain after completing a particular key stage of learning and serve as a tool for promoting learning and teaching.
Learning targets and learning objectives	➢ Learning targets set out broadly the knowledge/concepts, skills, values and attitudes that students need to learn and develop. ➢ Learning objectives define specifically what students should know, value and be able to do in each strand of the subject in accordance with the broad subject targets at each key stage of schooling. They are to be used by teachers as a source list for curriculum, lesson and activity planning.
Level Descriptors	A set of written descriptions that describe what the typical candidates performing a certain level is able to do in public assessments.
Other learning experiences	For whole person development of students, 'Other Learning Experiences' (OLE) is one of the three components that complement the examination subjects and Applied Learning (formerly named as Career-oriented Studies) under the senior secondary curriculum. It includes Moral and Civic Education, Aesthetics Development, Physical Development, Community Service and Career-related Experiences.
Product	A product can be an artifact, a system, an environment, or a service that satisfies people's needs and wants.
Public assessment	The associated assessment and examination system for the Hong Kong Diploma of Secondary Education.
SBA Moderation Mechanism	The mechanism adopted by HKEAA to adjust SBA marks submitted by schools to iron out possible differences across schools in marking standards and without affecting the rank order determined by the school.
School-based assessment (SBA)	Assessments administered in schools as part of the teaching and learning process, with students being assessed by their subject teachers. Marks awarded will count towards students' public assessment results.

Term	Description
School-based curriculum	Schools and teachers are encouraged to adapt the central curriculum to develop their school-based curriculum to help their students achieve the subject targets and overall aims of education. Measures may include readjusting the learning targets, varying the organisation of contents, adding optional studies and adapting learning, teaching and assessment strategies. A school-based curriculum, hence, is the outcome of a balance between official recommendations and the autonomy of the schools and teachers.
Standards-referenced Reporting	Candidates' performance in public assessment is reported in terms of levels of performance matched against a set of standards.
Student learning profile	It is to provide supplementary information on the secondary school leavers' participation and specialties during senior secondary years, in addition to their academic performance as reported in the Hong Kong Diploma of Secondary Education, including the assessment results for Applied Learning courses, thus giving a fuller picture of the student's whole person development.
Technological areas	In solving design and technological problems, students need to develop solutions and employ technical knowledge. Problems can be from a range of technological areas such as electronics, robotics, visualisation, computer-aided manufacturing (CAM) and digital media.
Values & attitudes	Values constitute the foundation of the attitudes and beliefs that influence one's behaviour and way of life. They help form principles underlying human conduct and critical judgment, and are qualities that learners should develop. Some examples of values are rights and responsibilities, commitment, honesty and national identity. Closely associated with values are attitudes. The latter supports motivation and cognitive functioning, and affects one's way of reacting to events or situations. Since both values and attitudes significantly affect the way a student learns, they form an important part of the school curriculum.

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