Design and Applied Technology

Introduction

1. Design and Applied Technology (DAT) is a curriculum aimed at developing in students the necessary attributes to face the rapid social, economic and technological changes in a knowledge-based economy. The existing school subjects under the Technology Education Key Learning Area (TE KLA) at S4-S7 levels were developed at a different time to meet the learning needs of students of that time. In the senior secondary education, DAT is positioned as a subject to prepare students to meet the new challenges through the contexts of Design and Applied Technology.

2. Some of the learning elements of the existing S4-S7 subjects still serve as effective learning platforms for DAT. These subjects include:

- ✧ Graphical Communication/Technical Drawing (S4-5)
- ✧ Design and Technology (S4-5)
- ✧ Design and Technology (Alternative Syllabus) (S4-5)
- ✧ Electronics and Electricity (S4-5)
- ✧ Technological Studies (S4-5)
- ✧ Design and Technology (ASL)
- ✧ Electronics (ASL)

3. Prior knowledge enabling the studies of DAT is acquired through students' 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" stipulated in the Curriculum Guide. The learning contexts involved in DAT and the related generic skills that will be developed through it will enable students to pursue a career and/or further studies in areas such as design, engineering, applied science and media communication.

4. DAT is one of the elective subjects offered under the TE KLA. A brief explanation of the role and position of TE at the senior secondary level can be found in the Appendix for subjects under Technology Education KLA on p.295.

Rationale

5. Design can be considered as a value-added process and it is the soul of a product. A good design can thoroughly remould our living and business, and significantly enhance the competitiveness of our products and services.

6. Design and technology are interwoven. In DAT, '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 the man-made world.

7. Hong Kong has many advantages as an international city: a very safe society, judicial independence, a level playing field, a prime location etc. However, as globalisation develops and inter-regional as well as inter-city competition intensifies, we cannot afford to be content with our existing advantages. Apart from core industries, (i.e. financial services, producer services, logistics and tourism), new opportunities for manufacturing will rest with high value-added production processes, such as new and advanced technologies to products and creative industries (e.g. films, publishing, architecture, advertising, various types of design and digital entertainment etc).

8. DAT serves to provide a learning platform for students to develop their basic knowledge and skills as well as positive values and attitudes in design and technology. It will equip students with generic skills (e.g. creativity, critical thinking, problem solving, communication, etc.) as well as serve as a taster for further studies and career development in the design and technology field. In the long run, it will help to attract more talents into design and hi-tech field and build Hong Kong into a centre for design and creative industries.

9. As the language of technology comprises predominantly concrete visual images, symbols, and models, DAT allows students to communicate and think in terms of forms and structures rather than abstract concepts. The interactive use of hands and mind helps to develop both the mental abilities and physical skills of students.

10. The aims of 21st century education are to widen students' horizons and consolidate their basic knowledge. The trend towards globalisation requires one to possess knowledge and skills from a wide range of disciplines such as business, technology, science, language and humanities, in order to work on tasks that are multi-disciplinary in nature. While students can build up a solid foundation in design and technology through DAT, they can also enrich their exposure to a range of areas by studying the subject in combination with other electives in a complementary way. For example, students may study DAT with Business, Accounting and Financial Studies to become business-oriented; DAT with Physics

or Information and Communication Technology to become more technology-oriented; DAT with Visual Arts to become more design-oriented, etc.

Curriculum Aims

11. The aims of the DAT curriculum are to enable students to:

(a) become informed and intelligent users of technology in today's ever-developing technological society;

(b) prepare for further studies and life-long learning in the design and technology-related field.

12. Through open-ended learning activities such as design projects, from inception to delivery, students are expected to:

(a) become autonomous and innovative problem solvers;

(b) develop their practical skills in design and become knowledgeable about design practices, enterprise and technological principles, with an awareness of aesthetic, social, cultural, ethical and environmental issues;

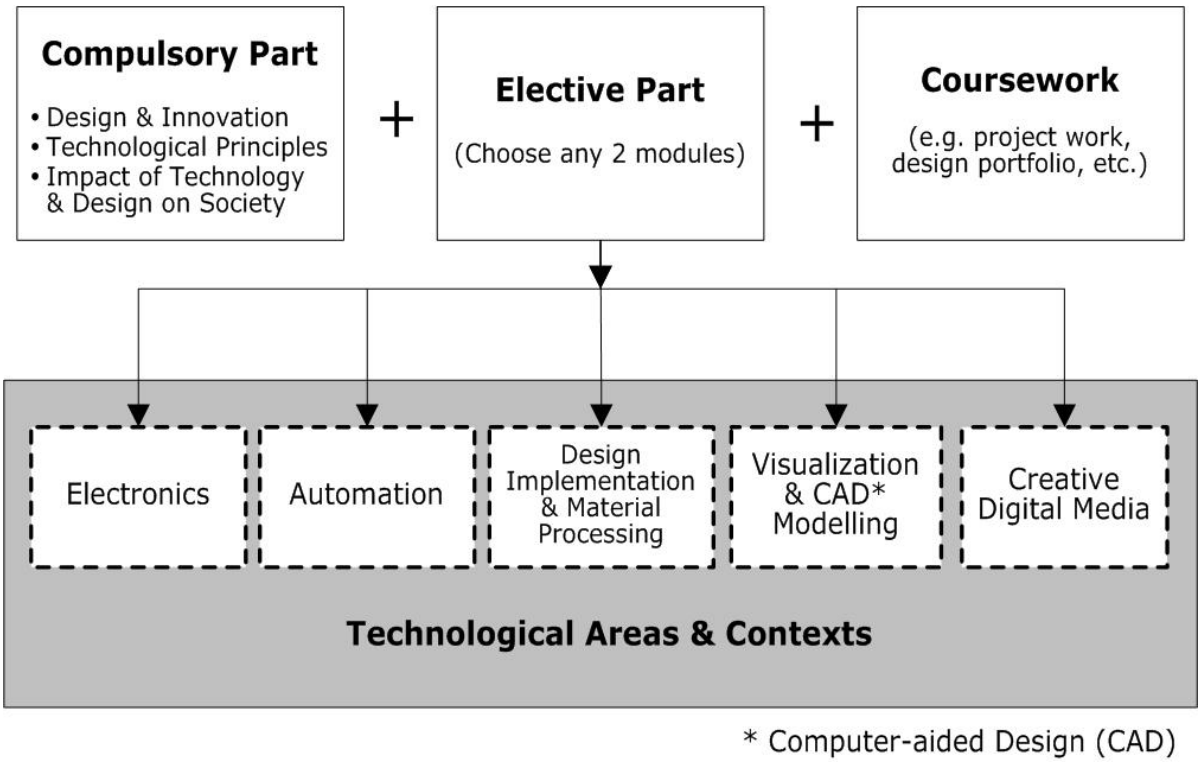
(c) identify needs, wants and opportunities in improving the quality of living and develop design and technological responses as well as entrepreneurship accordingly; and

(d) become discriminating, informed and responsible users of products/systems/services, and to develop their technological awareness to meet the demands of the changing world.

Curriculum Framework

(This part should be read in conjunction with the section "Curriculum Framework" of the Main Document. It should be noted that the curriculum framework suggested below is for initial consultation only. Feedback from the public will be taken into account and further details will be provided in the next stage of consultation.)

13. It is proposed to organize the DAT curriculum as below:



Compulsory Part

14. The compulsory part of the curriculum is designed to provide a platform to develop students' design and technological capabilities as well as positive values and attitudes. In the compulsory part, students are expected to develop:

(a) creative, analytic and critical thinking ability;

(b) design, modelling and communication skills;

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

(d) social, technological and entrepreneurship awareness.

15. The compulsory part may include the following learning elements:

- **Design and Innovation**
  - Design in practice
  - Design communication
  - Design considerations and product analysis
- **Technological Principles**
  - Nature of technology
  - Operations and manufacturing
  - Systems and control
- **Impact of Technology and Design on Society**
  - Values in technology and design
  - Historical and cultural influence
  - Entrepreneurship and enterprise

Elective Part

16. In solving a technological problem, students need to develop and employ knowledge from a range of knowledge domains. The elective part of the curriculum provides a range of interrelated modules from hard technology to soft technology. Students have to choose two out of the five proposed elective modules to further develop their knowledge and capabilities in design and technology. These knowledge and capabilities may include:

(a) The application of technologies in design contexts

(b) The use and operation of technologies

(c) Technological/design principles and systems

(d) The nature of technological/design practice

(e) The effects of technological/design processes

17. The elective part will include the following learning focuses and elements (Remarks: Modules may be updated and added or deleted according to the needs of students and the latest developments in technology):

Module	Learning Focus	Learning Element
Electronics	This module enables students to explore the design of electronic circuits. It focuses on electrical control and electronic products.	• Device, circuits and product • Analogue and digital electronics • Micro- controller and interfacing
Automation	This module enables students to explore the design of control systems. It focuses on the basics of systems, pneumatic control, computer control and robotics.	• Systems and control • Pneumatics • Computer control system • Robotics
Design Implementation and Material Processing	This module enables students to explore the conversion of some important raw materials to final products. It focuses on the implementation of design, material processing and on how Computer-aided manufacturing (CAM) is used in production.	• Materials, components and systems • Process and manufacture • CAM
Visualization and 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.	• Product modelling • Computer- aided design (CAD) • Technical and presentation graphics
Creative Digital Media	This module enables students to explore ways that messages and information are conveyed in a media-rich society. It focuses on the relationship between media products, their meanings and their producers and audiences.	• Communication process • Visual language for the digital age • Multimedia production and presentation • Media literacy

Coursework

18. Coursework in DAT may include design projects, case studies, technology explorations, etc. Students will be given the opportunity to demonstrate their capabilities in design and technology by participating in open-ended learning activities.

19. In coursework, students are expected to demonstrate their learning through the following properly documented evidence:

- **Design Process**
  - the identification of a design need;
  - statement on design tasks;
  - acquisition of the necessary skills;
  - modelling and fabrication of a prototype;
  - assessment of the feasibility, implementation, and value of the design;
- **Technological Understanding**
  - understanding of the operating principles and industrial practices of related technologies;
  - innovative uses of the technologies;
  - presentation of work and solicitation of feedback;
- **Technological Awareness**
  - appreciation and critique of a design from multiple perspective;
  - an assessment of the social value and impact of a product and/or a system.

Time Allocation

20. The total lesson time allocated to DAT is 255 hours. This includes not less than 55 hours for coursework. A rough estimation of time allocation is suggested below:

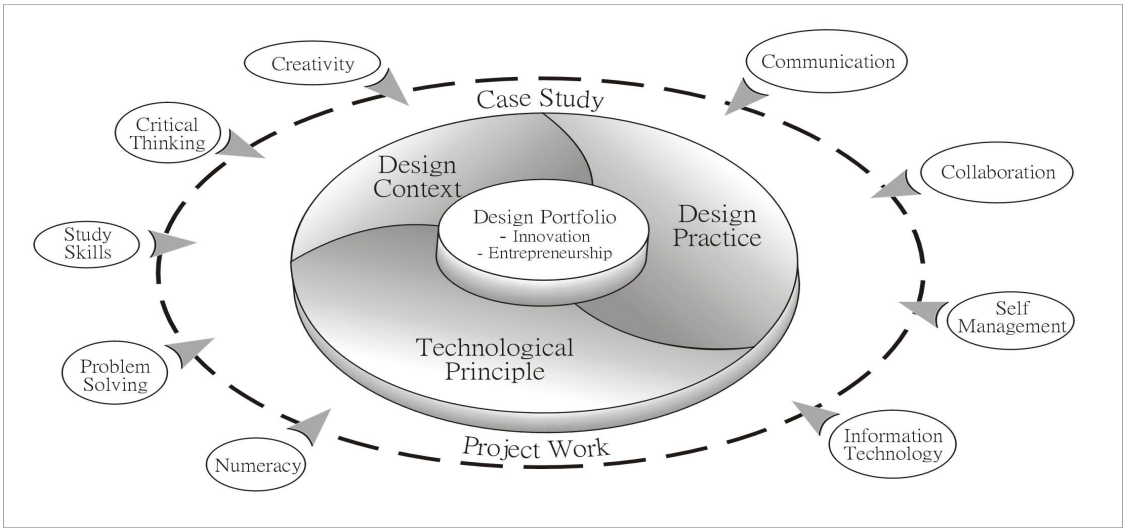
<table>
<tr><td>SS3</td><td rowspan="2">Elective Part
(120 hours: 2 modules of 60 hours each)</td><td rowspan="3">Coursework</td></tr>
<tr><td>SS2</td></tr>
<tr><td>SS1</td><td>Compulsory Part
(135 hours)</td></tr>
</table>

Learning and Teaching

21. The curriculum of DAT encourages the cultivation of creative ideas with tangible outcomes. Among others, innovation and entrepreneurship are the two core values in DAT. Students learn to suggest alternatives, tackle unexpected results and make failure analyses. 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 their learning process. These processes enable students to develop positive values and attitudes such as perseverance, resilience and risk-taking.

22. The conceptual framework of learning in DAT (Diagram 1) involves three interwoven strands, namely design context, design practice, and technological principle. Students develop the nine generic skills through design activities. In addition to the use of various learning tasks and activities, case study (Exemplar in Annex) and project work, which pertain to daily life experience rather than discipline-based technology, are highly recommended in the general teaching approach adopted for DAT.

Diagram 1: Conceptual Framework of Learning in DAT



Assessment

(This part should be read in conjunction with the section "Assessment" of the Main Document.)

Aims of assessment

23. Assessment is the practice of collecting evidence of student learning. The aims are to improve learning and teaching as well as to recognise the achievement of students. Assessment design for DAT should be aligned with the curriculum aims and framework, design and learning processes and expected learning outcomes. A range of assessment modes will be adopted to assess the various forms of student learning, for example:

- ✧ Task/Assignment – Authentic and hands-on activities to elicit the use of specific skills and knowledge on which teachers can provide feedback (e.g. ability to apply concepts and skills);
- ✧ Case Study – Students selecting an innovative product or an emerging technology, researching into the various features of the product or technology and their impacts on the individual, family and society, etc. (e.g. research into the latest model of mobile phones or the latest clothing technology and their impacts);

- ✧ Design Project – Producing a final deliverable which might be a real artefact or a working model of a system to address a design need or problem (e.g. design and make an innovative product); and
- ✧ Paper-and-pen test/examination - Structured extended response questions to test for understanding of knowledge and concepts (e.g. application of technology in relation to solving practical problems).

Internal Assessment

24. Internal assessment refers to the assessment practices that schools employ as part of the learning and teaching process during the 3-year study in DAT. It serves the purpose of providing feedback to improve learning and teaching as well as of reporting student progress at appropriate times (e.g. at the end of school year etc). In this sense, teachers and students are partners in a wide range of systematically planned, integrated learning and assessment activities designed to achieve the learning objectives of the curriculum.

25. The design of internal assessment will depend on a number of factors, including the nature of the subject, the culture of the school, the learning needs of the students, school-based curriculum planning etc. It may include assessment activities such as keeping a record of students' performance in the learning process; task-based exercises to assess students' understanding and mastering of a particular concept or skill, e.g. a working drawing to illustrate a three-dimensional object for production; more holistic tasks for students to demonstrate their abilities in applying the concepts and skills they have learnt in the subject, e.g. graphical presentation of an idea in a design project; as well as tests and examinations at appropriate times.

26. Schools may wish to adopt a system where students' learning progress in the subject can be recorded and reported over time, e.g., a portfolio to record and report students' achievement over time in major domains of the subject, with evidence.

Public Assessment

27. Public Assessment of DAT leads to a qualification in the subject to be offered by the Hong Kong Examinations and Assessment Authority (HKEAA). In the public assessment of DAT, a standards-referenced approach will be adopted for grading and reporting student performance. The purpose of this approach is to recognize what each student can do in DAT at the end of the 3-year senior secondary education. Each student's performance will be matched against a set of performance standards, rather than compared to the performance of other students. It makes the implicit standards explicit by providing specific indication of student performance. Descriptors will be provided for the set of standards at a later stage.

28. Initial proposal on the public assessment of DAT will include two components:

(a) Written examination

- Two papers accounting for 60% of the total weighting are suggested.

	Duration	Weighting	Remarks
Paper One	2 hours	30%	Questions will be set to examine the compulsory part of the curriculum.
Paper Two	1.5 hours	30%	Questions will be set to examine the elective part of the curriculum.

(b) School-based Assessment (SBA)

- DAT emphasizes experiential learning and values students' attributes such as initiative, resourcefulness, risk-taking, responsibility, adaptability, entrepreneurship, etc. DAT also emphasizes the hands and mind interaction. These cannot be easily assessed through a written examination. There is therefore a need for this subject to accord a high percentage to SBA in public assessment, where the various attributes can be better assessed.
- The public assessment of DAT will therefore include an SBA component accounting for 40% of the total weighting of public assessment. The merits of adopting SBA are as follows:
  (i) SBA provides a more valid assessment than an external written examination, since it can cover a more extensive range of learning outcomes through employing a wider range of assessment practices that are not necessarily possible in written examinations.
  (ii) SBA enables the sustained work of students to be assessed. It provides a more comprehensive picture of student performance throughout the period of study rather than their performance in a one-off examination alone.
- It should be noted that SBA is not an "add-on" element in the curriculum. Assessing students' performance through practices such as class discussion and class observation is a normal in-class and out-of-class activity. The assessment modes selected for SBA in DAT will be appropriate to the learning objectives and processes that are to be assessed. The design and implementation of SBA should avoid unduly increasing the workload of both teachers and students.

- A possible design of SBA could be:

	Duration	Weighting	Remarks
Coursework Assignments	Continuous mode	10%	Portfolio of students' progress in learning, including activities such as case studies, technology explorations, mini design projects, etc.
Major Design Project	No more than 35 hours	30%	• A major design project for each student is proposed. • Students will probably be asked to document all the steps they had taken in carrying the project through to realisation in a folder. • Students will be requested to submit also relevant models/prototypes of a product/system and/or their environment.

Supporting Measures

29. To support schools to implement the curriculum, a DAT Curriculum and Assessment Guide will be published to provide information on the curriculum aims, learning objectives, learning targets, course requirements and examination. The Guide will also serve as a framework to guide teachers on the teaching content, suggested pedagogies and learning strategies, and SBA. Other support materials may include sample examination questions and guidelines on the implementation of SBA.

30. A wide range of learning resources related to DAT is currently available on the web. The Education and Manpower Bureau (EMB) will work with organizations and tertiary institutes to provide learning resources for schools and teachers to adapt as appropriate. These will include learning and teaching packages with teacher and student manuals, try-outs, deliverables from professional development programmes, as well as their follow-up evaluation and subsequent revision and fine-tuning of the learning and teaching packages.

31. A series of professional development programmes for teachers will cover topics such as understanding and planning the curriculum, knowledge updating, and examination and assessment will be provided as appropriate to prepare teachers to implement the proposed curriculum.

32. Some programmes offered by the EMB, in collaboration with other institutes, are also relevant to DAT. The following relevant information can be accessed from http://tds.ic.polyu.edu.hk via a 'guest' account:

(a) Web-based Course on Design Studies: (A) Design Basics, (B) Product Design, (C) Communication Design

(b) Web-based Course on Modern Technology Updates: (A) Automation and Modern Production Techniques, (B) Smart Home and I.T.

(c) Course materials on Technological Design

(d) Course materials on Visual Communication

(e) Other design/technology-related learning and teaching materials

Annex

Exemplar on Case Study

Design Thinking: Innovative Ideas – SONY Walkman

Overall Expectation

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

The Case

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.

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 ***advance 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.

(visit www.sony.com for more information)

Suggested Activities

1. Keeping an open mind: free your minds
2. Working together: as team to solve problems
3. Whose life is it?: analyse information collected
4. Observation exercise: in-depth interviewing and role-playing exercises to establish what users really want from a product
5. Making your ideas happen:
   - Brainstorming: product ideas
   - Developing ideas: best and practical ideas
   - Rapid prototyping: cardboard / foam board, etc.

(Source: Resource Pack http://www.designmuseum.org)

Learning Outcomes

Student should be able to:

- develop design thinking skills by making use of relevant tools and methods such as concept map, brainstorming, etc.
- consider various factors, such as cultural, social and economical, in design
- analyse product from multiple perspectives
- present ideas using verbal and graphical means
- evaluate materials, structure and mechanism of a walkman
- describe briefly how the control system works in a walkman

What to Learn?