Design & Technology Syllabus

Lower Secondary

Special / Express / Normal (Academic) course

CURRICULUM PLANNING & DEVELOPMENT DIVISION
MINISTRY OF EDUCATION
SINGAPORE

© Ministry of Education
All Rights Reserved
Year of Implementation from 2001

DESIGN is the process of **identifying, investigating** and **analysing** problems; **researching** existing ideas and **generating** new ideas; **proposing** and **realising** solutions; and **evaluating** the outcome to see if the problems have been solved.

TECHNOLOGY is the **understanding** and **application** of concepts, functions, properties of materials, processes, etc., to solve practical problems or realise an artefact.

contents

aims

to promote problem-solving design activity

to develop knowledge of a range of common materials and basic processes

to develop appropriate technical skills for the realisation of design ideas

to develop basic graphical skills for communication

to promote the use of information technology in research and design work where appropriate

to develop an awareness of possible hazards in school workshops and encourage safe working habits

to develop an understanding of some aspects of technology

design & technology *for* lower secondary

1 introduction

The Design & Technology (D&T) programme for Lower Secondary pupils in the Special/Express/Normal (Academic) course is largely coursework based. The programme aims to harness the creative and inquisitive instinct of pupils to bring it to fruition in the problem-solving approach to design. Pupils are engaged in self-directed learning and time management in working on the coursework. Pupils apply thinking skills, the elements of design and, at the same time, develop an appreciation of aesthetics. The concept of 'design process-in-action' is phased in at the lower secondary level to prepare them for the upper secondary D&T programme.

The revised lower secondary D&T syllabus allows for the infusion of, where appropriate, the three initiatives arising from the "Thinking Schools Learning Nation" vision, namely, thinking skills, National Education and the use of IT.

2 description of the subject

The subject will involve pupils in the following areas:

- acquisition of problem-solving skills through the use of the design process
- study of the 3 basic materials - wood, metal and plastics
- acquisition of manipulative skills using hand tools and simple machines
- use of basic technical graphics for communication
- use of information technology, where applicable, in research and design work

3 rationale and objectives

Design & Technology is included as a compulsory examination subject in the lower secondary curriculum to contribute to the all round development of pupils.

The programme will prepare pupils for living and working in a technological world. It will also help young people to recognise the need for new or modified products/systems and give pupils the capacity and confidence to ***design, make and evaluate*** these products/systems for themselves. The programme will also contribute to the development of the pupils' psychomotor skills and the inculcation of desirable work attitudes through the acquisition of practical skills and realisation of artefacts.

4 nature of programme

The programme is design-centred (figure 1). Pupils are taught the design process and have the opportunity to work with a variety of materials, particularly, wood, metals and plastics. This will help them acquire knowledge of a range of common materials and develop manipulative technical skills to realise solutions to design problems. While providing for instruction in the use of tools and materials, the programme also encourages pupils to think and generate ideas and focuses on creativity and aesthetics.

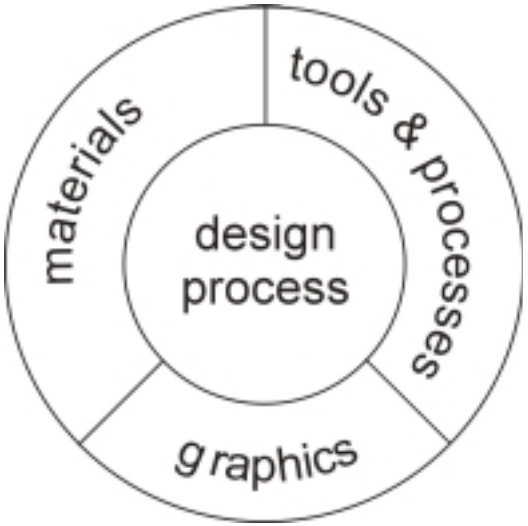

figure 1 : design-centred programme

5 the design process

The design process adapted for the lower secondary level is illustrated in figure 2 on page 8. The various steps are listed below:

define problem :

- to identify and define the problem
- to state the design brief (a short statement to indicate what is to be designed and made)
- to list the specifications (requirements) - it should 'spell out' exactly what the design must achieve whilst taking into account the constraints

explore ideas :

- to investigate existing ideas
- to generate new ideas
- to select one idea for further development

develop idea :

- to develop the selected idea towards a working solution

- to consider possible
  - materials
  - shapes with main dimensions
  - joints and construction methods
  - surface finishes

  before arriving at a particular choice

plan :

- to furnish enough information and plan for the making of the solution (product). The following may be included:
  - material list
  - working drawings
  - operation sequence

make :

- to construct the product using information/ details developed

evaluate :

- to test the product to find out if it solves the identified problem successfully

- to suggest possible improvements

6 structured design activities

As design activities should progress from a narrow or 'closed' approach to a more 'open-ended' approach, it is suggested that teachers at the lower secondary level begin with a range of structured exercises. Each exercise could focus on only 1 or 2 aspects of the design process. This would enable pupils to concentrate and dwell sufficiently on each aspect of the design process. Pupils may then progress to take on at least 1 project that requires them to work through all the aspects of the design process.

7 framework of the design & technology programme

The **Framework of the Design & Technology Programme** at lower secondary is provided in table 1 on page 9 to assist teachers in understanding the scope and the level of treatment of the respective topics in the syllabus.

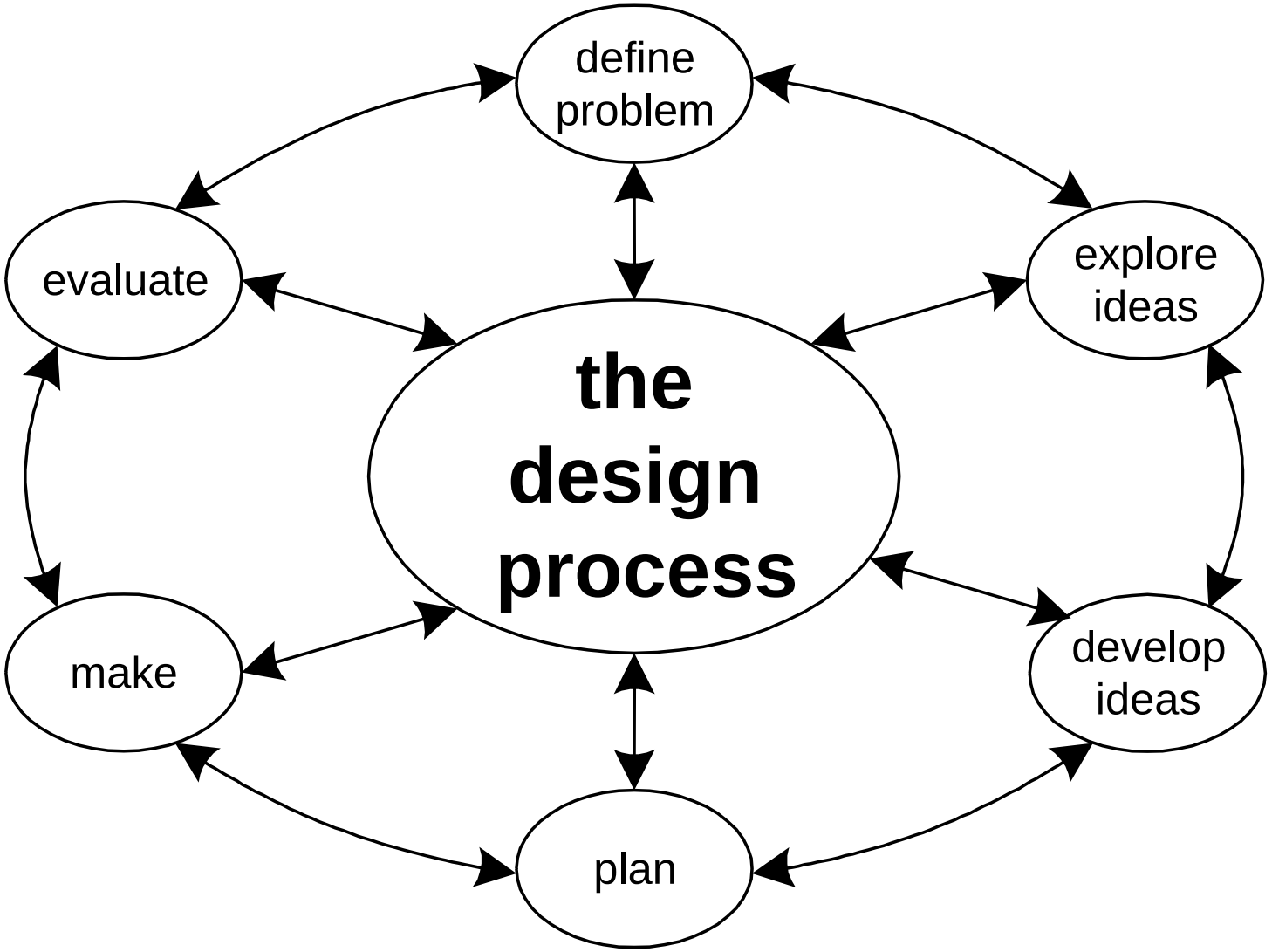

figure 2 : the design process for lower secondary level

content		weighting
1	**materials**	10%
	- wood, metals, plastics	
2	**tools & processes**	10%
	- marking-out and measuring, cutting, shaping, holding, bending, forming, jointing, finishing	
3	**safety**	5%
	- general workshop rules, safety precautions, safety consciousness	
4	**graphics**	15%
	- freehand sketching; isometric drawing, multi-view drawing, preparing working drawings	
5	**design activities and practical work**	60%
	- structured exercises	
	total	100%

table 1 : framework for lower secondary design & technology

course outline

8 course outline

secondary 1

I materials

- wood
  - classification
  - types of solid timber - jelutong, meranti, ramin, teak
  - types of manufactured boards – chipboard, plywood, softboard

- metals
  - classification
  - ferrous metals - cast iron, mild steel, stainless steel, tool steel,
  - non-ferrous metals - aluminium, brass, bronze, copper, duralumin, lead, tin, zinc

- plastics
  - classification
  - thermoplastics - acrylic, nylon, polyethylene, polystyrene, polyvinyl chloride (PVC)
  - thermosets - glass reinforced polyester (GRP), melamine

II tools and processes

- marking-out and measuring
  - dividers, marker pens, marking gauge, marking knife, odd-leg calipers, pencil, punches, scriber, steel rule, try square

- cutting, shaping and holding
  - bench drilling machine, chisels, coping saw, countersinking bit, files, hacksaw, hammers, holding devices, mallets, rasps, scroll saw, smoothing plane, surforms, tenon saw, twist drill

- bending and forming
  - folding bars, jigs, strip heater

- jointing
  - glues, nails, rivets, screws, solvents

- finishing
  - buffing machine, emery cloth, glass paper, lacquer, liquid polish, paints

III safety

- safety precautions related to
  - workshop practices
  - tools and processes

IV graphics

- introduction
  - the importance of graphics as a tool for communication

- freehand sketching
  - straight lines (horizontal, vertical and slanting), circles
  - outlines of objects using grids and the guidelines, proportions and outline (GPO) method
  - isometric drawings using grid and plain paper
  - first angle orthographic projection using grid and plain paper

V design activities and practical work

- structured exercises
  - formulating design briefs and specifications from given problems
  - generating and developing ideas
  - realising solutions (using materials, tools and processes listed in I on pages 11 & 12)
  - evaluating final products

note: The three major initiatives, IT, thinking skills and National Education should be infused, where appropriate, in the lessons.

secondary 2

I materials

- wood
  - types of wood - chengal, kapur, nyatoh

- metals
  - ferrous metals and its alloys - carbon steels, high speed steel
  - non-ferrous alloy - pewter

- plastics
  - thermosets – phenolic, urea resin

II tools and processes

- marking-out
  - protractor, sliding bevel, templates

- cutting and shaping
  - abrafile, drill bits, hole saw, snips

- bending and forming
  - bending metal – formers, jigs
  - thermoforming plastics – formers, jigs, moulds, oven

- jointing
  - adhesives, cements, fastenings using screw threads, joints, knock-down fittings, pop riveting, soldering (electrical), solvents

III safety

- safety precautions related to
  - tools and processes

IV graphics

- pictorial drawing
  - isometric drawing

- preparing working drawings
  - dimensioning
  - drawing in first angle orthographic projection
  - material list

V design activities and practical work

- structured exercises
  - identifying problems
  - formulating design briefs and specifications
  - generating, developing and refining of ideas
  - realising solutions (using materials, tools and processes listed in I and II on page 14)
  - evaluating final products

note: The three major initiatives, IT, thinking skills and National Education should be infused, where appropriate, in the lessons.

assessment guidelines

9 assessment guidelines

- **semestral assessment (SA)**

There are two semestral assessments a year, one at the end of each semester. The details of the examination structure suggested for both Sec 1 and 2 are provided in table 2 on page 18.

paper 1:	*40% of marks for subject.*
(written)	This is a formal timed examination in which pupils will be required to show their knowledge and understanding of materials, tools, processes and graphics.
paper 2:	*60% of marks for subject.*
(coursework)	Pupils are expected to complete a series of structured/non-structured design projects assigned by their teacher/s and will be required to demonstrate ability in design, communication and craftsmanship.

Details of the paper for Secondary 1 are indicated in table 3 on page 19 and those for Secondary 2 in table 4 on page 20.

- **continual assessment (CA)**

Continual assessment forms an integral part of the teaching-learning process. It can be regarded as a kind of formative evaluation, the aim of which is to find out how effective the teaching process has been and the strengths and weaknesses of the pupils with a view to taking corrective measures where necessary.

Teachers have the flexibility to decide on the methods of testing (e.g. written assignments, parts of or a whole design project) when conducting CAs. However, in order to obtain an accurate assessment of the pupils' progress, it is essential to ensure that the 'tests administered' measure both theoretical knowledge as well as competency in the design projects. The weighting for both the components (i.e. 40% for theoretical knowledge and 60% for design projects) should be maintained when incorporating pupils' attainment in CAs into their overall performance in the subject for the semester/year.

semester	component	duration	weighting	weighting sub-total
first (mid-year exam)	paper 1 written	1 hour	16%	40%
	paper 2 coursework	-	24%	
second (final exam)	paper 1 written	1 hour	24%	60%
	paper 2 coursework	-	36%	
total weighting				100%

table 2 : examination structure for secondary 1 & 2

paper 1 : written					
part	section	item type	number of questions to attempt	marks	weighting
a: materials, tools & processes	**I**	fill in the blanks [for special & express courses] or multiple-choice [for normal (academic) course]	10	20	20%
	II	free response (short answer type)	5	30	
b: graphics	-	questions requiring graphical solutions	3	50	20%
paper 2 : coursework					
design projects (structured and non-structured)			2-3 projects per year	100	60%
			total weighting		**100%**

table 3 : details of examination papers for sec 1

paper 1 : written					
section	item type	number of questions set	number of questions to attempt	marks	weighting
I	fill in the blanks [for special & express courses] or multiple-choice [for normal (academic) course]	10	10	20	8%
II	free response (short answer type) based mainly on tools and materials	3	3	60	24%
III	structured essay type based mainly on processes	3	1	20	8%
paper 2 : coursework					
design projects (structured and non-structured)			2-3 projects per year	100	60%
			total weighting		**100%**

table 4 : details of examination papers for sec 2

10 suggested references

no	title	author	publisher	year
1.	A Whack In The Seat Of The Pants	Roger von Oech	Warner Books	1986
2.	A Whack On The Side Of The Head	Roger von Oech	Warner Books	1990
3.	An Introduction to Graphic Communication	Abate/Umberto	Longman	1995
4.	Approaching Design & Technology	M Wright & G Royle	John Murray	1990
5.	CDT for GCSE	Peter Toft	Heinemann	1987
6.	Collins Design & Make Assignments	Stewart Dunn	Collins Educational	
7.	Collins Design & Technology Foundation Course	Mike Finney, Colin Chapman & Michael Horsley	Collins	
8.	Collins Electronics Tasks and Assignments	Stewart Dunn	Collins Educational	
9.	Communicating Design	Tom Baird	Heinemann	1990
10.	Communicating Design: Graphic Products, Graphic Communication	Mike Finney & Val Charles	Collins	
11.	Craft and Design in Wood	David M Willacy	Stanley Thornes	1992
12.	D&T Challenges	Royal College of Art Schools	Hodder & Stroughton	1995-99
13.	D&T Routes	Royal College of Art Schools	Hodder & Stoughton	1996-98
14.	Design & Communication for GCSE and Standard Grade	Richard Turnfell	Stanely Thornes	1994
15.	Design & Make It!: Electronic Products	Dave Mawson, Paul Bell, Philip Poole, Tristam Shepard	Stanley Thornes	1997

10 suggested references

no	title	author	publisher	year
16.	Design & Make It!: Product Design	Tristram Shepard, Melanie Fasciato, Diana Mitchell	Stanley Thornes	1998
17.	Design & Make It!: Systems and Control Technology	Andy Biggs, Mike Hoffman, Tristram Shepard	Stanley Thornes	1998
18.	Design & Plastics	Mike Hall	Hodder & Stroughton	1988
19.	Design & Technology	Caborn, Mould & Cave	Nelson	1999
20.	Design & Technology 1 & 2	CPDD	Longman	1998/1999
21.	Design & Technology through Problem-solving	Robert Johnsey	Simon & Schuster	1990
22.	Design and Communication	M Finney & K Cramption	Collins	
23.	Design Graphics	David Fair and Marilyn Kenny	Hodder & Stroughton	
24.	Design in the Making: Resistant Materials	Steve Cushing	Longman	1999
25.	Design Presentation	David Beaseley	Heinemann	
26.	Dimensions of Thinking – A Framework for Curriculum and Instruction	Robert J Marzano	ASCD	1988
27.	GCSE Technology – Mechanisms	Steve Rich & Anthony Edwards	Stanley Thornes	1991
28.	GCSE Technology – Structures with Materials	Steve Rich	Stanley Thornes	1991
29.	How to get Ideas	Jack Foster	Berrett-Koehler Publishers	1996
30.	Introducing Design and Communication	Richard Tufnell	Hutchinson	1986

10 suggested references

no	title	author	publisher	year
31.	Introducing Technology - A text for Australian secondary schools	Basil Slynko	Moreton Bay Publishing	1991
32.	Nuffield Design & Technology Project	David Barlex, Paul Black & Geoffrey Harrison	Longman	1995
33.	Product Design	S Atkinson & C Mockford	Oxford	1991
34.	Projects for Design & Technology in Wood, Metal and Plastics	W R Hodder	John Murray	1982
35.	Rapid Viz – A New Method for the Rapid Visualization of Ideas	Hanks & Belliston	Crisp Publications, Inc	1990
36.	Skills in Design and Technology	Jenny Ridgwell & Louise Davies	Heinemann	
37.	Technology Activity Book 1 & 2	E Mazurkiewicz & B Slynko	Morton Bay Publishing	1995
38.	The Mind Map Book	Tony Buzan	BBC Books	
39.	Think Out Of The Box	Mike Vance & Diane Deacon	Creative Thinking Association of America	1995
40.	The Universal Traveler	Don Koberg & Jim Bagnall	Crisp Publications, Inc	1991
41.	Use Your Head	Tony Buzan	BBC Books	1995

Footnote: The list of reference books above is by no means exhaustive. It is included to provide teachers with an array of reference materials which teachers may wish to draw upon as resource materials for the teaching and learning of Design & Technology. Some of the books listed are content based while others are for personal development in creative thinking and design related knowledge. It is hoped that schools would build a repertoire of reference materials for teachers' and pupils' reference.