Relevant Knowledge

I Basic Elements of Design

1. Design Movements

In the early stages of design, natural materials and simple hand tools were used mainly to achieve various purposes. Only kings, nobles and the rich could request and use decorative articles. Each of those articles could be considered as a unique work of art. During the Industrial Revolution, machine-production was promoted and encouraged. Design became uniformity, which was blamed by some who viewed that design has become lifeless.

Design movements were art movements for the changes in international design trends and style as a result of the improvement of production methods, advanced on crafts and the changes in consumer standard. The movements originated mainly in Europe and America.

a. Arts and Craft Movement (about 1880 to 1910)

The movement developed mainly in the 19th century. It attempted to find a special and useful style as a refutation of the 'spiritless' products made by machines due to the Industrial Revolution. Some members of the movement regarded that machines were the roots of repetition and human evil. Therefore, they gave up using machines completely and used handcrafts instead. Although Arts and Craft Movement was more than somewhat the introspection of industrialisation, it was neither anti-industrialisation nor anti-modernisation. Some European artists considered that machines were necessary but they should be used for reducing simple and redundant tasks only. Meanwhile, some artists involved in Arts and Craft Movement viewed that products should be at low price.

b. Art Nouveau (from 1880s)

At that time, many new materials appeared including iron, steel, glass panel and cement, which led architecture to enter the stage of using reinforced concrete and cement. The then designers and those working for creative design came across the new materials and new skills. They considered that new forms must be created at the new age. Thus, curvatures were adopted as the main part of free artistic form in the then architecture, industrial products, furniture, etc. Unlike traditional forms, the design was often filled with organic pattern and used more curvatures.

Art Nouveau Chair

The Kom Tong Hall (Dr. Sun Yat-sen Museum) in Sheung Wan was built in the Edwardian classical style, but decorated with the then popular Art Nouveau pattern.

Art Nouveau decoration

c. Art Decoratifs / Art Deco (from about 1925 to 1930s)

Art Decoratifs adopted geometric figures and the shapes of stairs. It used modern and simplified decorations, and emphasised the sense of symmetry and magnificence. Meanwhile, Art Decoratifs had influenced on the style of architectural design. It adopted fine, rare, precious materials and stressed the elegance of decorations. In the early days of Hong Kong, much architecture belonged to Art Decoratifs.

A school in Art Deco style (Main building of Aberdeen Technical School)

d. De Stijl (from 1917)）

De Stijl was a Dutch artistic movement founded in 1917. Proponents of De Stijl advocated pure abstraction and universality by a reduction to the essentials of form and colour. They simplified visual compositions to merely vertical and horizontal directions, and used only primary colours along with black and white.

Special creation in De Stijl period – Red and Blue Chair

e. Bauhaus (1919-1933)

Bauhaus was an art and architecture school in Germany. The school had a profound influence on modern architecture. Nowadays, Bauhaus not only represents a school, but is also collectively known as the architectural branch or style advocated by the school. It emphasises the harmony between the function and design in architecture.

The design of this movement often adopts rectangles, asymmetry with a sense of rhythm, and has a high regard for the characteristics of materials and Functionalism – ‘form follows function’.

Central Market in Bauhaus style

Knitted chair with hanging legs in the shape of steel pipes, in Bauhaus style

f. Modernism (from 1890s)

Modernism is based on Science. It emphasises rationality, logic, and empirical evidence. Typical modernist buildings contain flat roofs, exterior walls with simple painting, windows arranged horizontally, while in the absence of unnecessary decorations.

City Hall in Central

g. Pop Art (popular in 1950s to 1970s)

Pop art was an art movement investigating the relationship between popular culture and fine art. It attempted to overthrow abstract expressionism and changes to the theme of popular culture such as symbols and trademarks. It was the predecessor of the current bottom level art market. The characteristic of pop art was its special and long-lasting influence on the trends. Many fashion designers and graphic designers got inspiration directly or indirectly from pop art.

Head portraits of Marilyn Monroe in pop art style

Popular package design in pop art style

h. Cubism (from 1950s)

Cubism was the most important avant-garde movement in 20th century. It had different influence on various modern arts. Cubists concerned how to represent the natural shape of three-dimensional to even four-dimensional objects on a plane. The development of modern science and technology in the 20th century led to a challenge to the basic concept of 'time' and 'dimensions', etc. in traditional sense. Thus, painters then expressed the nature by science rules that were closer to the modern concept. The rule was to re-form the images of objects according to the structure.

Girl before a Mirror (Pablo Picasso)

i. Post-modernism (from 1970s)

Post-modernism was a response to the rationality and the 'boring' international style. It adopted decorations and colour again, returned to cultural art, and responded to the historical architectural style and design.

Post-modern graphic design can be classified into several directions:

1. New Wave Graphic Design Movement' was introduced by a Swiss called Basel and several designers who are closely related to the internationalist graphic design movement in Switzerland.

Post-modern architecture
(Jardine House in Central)

2. In Italy, designers of Memphis group strove very hard to perform various cultures with individualism and different delights from naive, humour and even freak. They often intentionally broke the rules of usual colour combination. They preferred bright and rich colours such as pink and light green.

Masterpiece of post-modern furniture
Bookshelf of Memphis group

3. In the late 1980s, design was developed by using Macintosh - desktop personal computers.

Macintosh in 1998

iMac G3 in 1998

The selling places had unique designs.

2. Freehand Sketch and Projection Views

In Secondary 1, students have already learnt to express design ideas by sketching. Now, we are going to introduce several two-dimensional and three-dimensional drawing methods that are often used to express design ideas. Although the drawings shown in the introduction are made by drawing tools, freehand sketching is often used at the stage of design idea generation. It increases the speed so as to prevent interruption to creative thinking.

Some Categories of the Pictorial Drawing:

Orthographic drawing

Perspective drawing

Isometric drawing

Oblique drawing

a. Perspective Drawing

Perspective drawing is a kind of pictorial drawing. It assumes that a viewer observes an object from a distance away. The object is scaled relative to the viewer due to the distance.

Perspective drawings consist of lines and vanishing points. A vanishing point acts as the eyes of a viewer who is observing an object. There are three types of perspective drawing, namely

(a) One-point perspective
(b) Two-point perspective
(c) Three-point perspective

Three concrete buildings are shown with three different types of perspective drawing techniques.

(i) One-point perspective

There is only one vanishing point for a one-point perspective drawing. This perspective joins all lines towards that single vanishing point. It is typically used in interior design drawings and window displays.

A one-point perspective drawing in interior design

A one-point perspective drawing in exterior design

(ii) Two-point perspective

There are two vanishing points for a two-point perspective drawing. This perspective shows the depth and space of an object to be more real and accurately. Two-point perspective drawings are typically used in architecture design and daily life objects.

A two-point perspective drawing in architecture design

(iii) Three-point perspective

Three-point perspective is often used for viewing buildings from above or below. In addition to two vanishing points at the viewer's eye level, a third vanishing point is put under or above the ground.

A common example of a three-point perspective is looking up at a tall building, where the third vanishing point is located at somewhere in the sky.

b. Orthographic drawing

Orthographic projection is to represent a 3D object with several plane drawings. It is to view a 3D object from three different directions, such as the front, side and above, and project the object's actual plane surface onto paper.

(a) Elevation *(b) End view* *(c) Plan*

Orthographic Projection

(a) Elevation、End View and Plan

(i) Elevation

Observe an object from the front. The image of the object is projected on the projection plane at the back. This projected image is called the elevation.

(ii) End view

Observe an object from either side. The image of the object is projected on the projection plane at the back. This projected image is called the end view.

(iii) Plan

Observe an object from the above. The image of the object is projected on the projection plane below. This projected image is called the plan.

There are two kinds of orthographic projections: first angle projection and third angle projection. Here, we use a mobile phone to demonstrate these two types of orthographic projections. Can you spot the difference between them?

Elevation *End view*

Plan

First angle projection

Plan

End view *Elevation*

Third angle projection

(b) First Angle Projection

In the first angle projection, the images of an object are projected at the back of the object and are then changed to plane views.

(a) Projections at the back

(b) Remove the object

(c) Plane views

Symbol for the first angle projection

First angle projection

Example: Drawing by the first angle projection

Draw projection lines between the end view and the plan

Drawing three views of projections

(c) Third Angle Projection

In the third angle projection, the images of an object are projected at the front of the object and are then changed to plane views.

(a) Projections at the front

(b) Remove the object

(c) Plane views

Symbol for the third angle projection

Third angle projection

Steps for drawing the orthographic projection

The following should be noted when the third angle projection is used:

(a) Reserve sufficient space for the required views;
(b) Heights of objects in the elevation and end views should be at the same level;
(c) Obtain a plan view by viewing the elevation from the top and projecting downwards.
(d) Keep the corresponding points on the same vertical line;
(e) Ensure that the thickness in the plan is equal to the width in end views;
(f) Position the views with the same method, but not any other ways;
(g) Use short dashed lines to represent those hidden outlines and edges;
(h) Draw dimensions lines, and
(i) Add explanatory texts when necessary.

Example: Draw by the third angle projection

Draw projection lines between the end view and the plan

Drawing three views of projections

c. Isometric Drawing

The figure on the right is an isometric drawing of a rectangle. By distortion of the figure, the results of observation from the front, the left and the above are shown in a drawing. This drawing can show the three-dimensional view of the object.

(Take the corner F as the lowest point)

i. Steps for Isometric Drawing

The following should be noted when the isometric drawing is used:

1. Reserve sufficient space for the required views;

Draw thin lines for construction:

2. Draw a vertical line in a suitable position as the height;
3. Draw the 30o lines on the left and right as the length and width;
4. From the elevation or the plan, move the length to the 30o line on the right and make a mark;
5. From the end view or the plan, move the width to the 30o line on the left and make a mark;
6. From the mark, draw a vertical line.
7. From the elevation or the end view, move the height to each vertical line;
8. From the mark, continue to draw the 30o lines on both left and right;

Use thick lines for outlines:

9. Draw the edges of the object
10. (The isometric drawing does not include hidden outlines and edges in general.)

ii. Draw the Inclined Lines of the Isometric Drawing

In isometric drawing, the heights are drawn on vertical lines while the lengths and widths are drawn on 30o lines on the left and right. For inclined lines in isometric drawing, the measures should be transferred from the orthographic drawing by its length and width, length and height, or width and height.

iii. Drawing Circle in Isometric Drawing

1. By using the diameter of a circle as the length, draw the isometric projection plane for the circle.

2. Make a mark on the point where the circle and the frame meet.

3. Draw an arc passing through two points on the frame.

Try to move the position of the finger or bend the fingers so as to draw the arc in one go.

4. Continue to draw the other three arcs so as to complete the isometric drawing of the circle.

iv. Drawing Cylinder in Isometric Drawing

1. Draw one end of a cylinder using the method on the previous page.

2. Measure the length of the cylinder. Draw the two ends and the top of the isometric drawing. Finally, draw the back of the cylinder.

3. Draw the back of the cylinder using the method on the previous page.

4. Join the edges of the circles at both ends. Finally, draw the cylinder with thick lines for the outlines.

d. Enhancing the 3D Visual Effects of Design Products

Visual representation involves visual enhancement techniques as follows:

(i) Thick and thin lines
(ii) Shading
(iii) Highlighting

(i) Thick and thin lines

They are mainly used to draw 3D figures. Their main purpose is to produce the senses of distances and shading in a picture so as to highlight the outline of an object. The place where two planes meet is represented by a line segment. Line weights must be selected according to the following rule:
A thick line indicates the edge of a hidden surface of two adjacent surfaces, otherwise use thin lines.

We can use similar methods to draw an arc. But, we must notice that the line segment between a thick line and a thin line should be connected smoothly.

(ii) Shading

Shading is the application of an appropriate level of darkness through the use of light and shadows to provide readers with a feeling of "depth". There are two types of shading, namely line shading and tone shading.

1. Line Shading

(i) Using different line thickness and densities to represent the light and shadows of an object;

(ii) For example, using low line density to enhance the light surface of an object.

(iii) The following cube is another example. It makes use of different densities of lines to enhance the layering effect of the object.

Low line density shows the light surface of a cylinder

A cube is represented in different densities of lines

2. Tone Shading

(i) Including shading in an object with back edge lines and white highlights

(ii) Showing different brightness and shadows on an object for light sources from different positions

(iii) Using different darkness of the same colour to enhance the tone shading

Light sources from different positions give different shading effects on the same object.

White colour on one side, and different darkness of another colour for the rest two

Three sides of the same colour with different darkness

3. Pencil Shading Technique

Firstly, we fix the position of light source and then determine the darkness level (brightest, dark and darkest) for each of the visible surfaces.

If a darker tone is used for a light surface in painting, then the dark and darkest surfaces will become darker accordingly, and vice versa. Besides, the brightness tone is expressed as a light surface without any sketch painting.

Light/dark surface	Shading
light surface	without any shading
dark surface	soft shading
darkest surface	strong and dense shading

Pencil shading effects on a cube by using a 2B pencil

i. Prisms, Pyramids and Spheres with Shading Effects

Common daily necessities develop from simple solids. Different solids give different shading effects.

(a) Hexagonal prism

(b) Octagonal pyramid

(c) Cylinder

The shading effect of curve surfaces can produce a sense of gradual changes by using different tones. After we have mastered the drawing methods for shading different basic geometric objects, the shading effects of some more complicated design artefacts can easily be presented.

(a) Sphere

(b) Cone

ii. Shading

When we do the cut and paste of plane figures or objects on the computer, the pictures are always lack of a sense of reality and seem to have something missing. Do you know what effect is missing? Apart from the mismatch of the shading effects on the object and the settings within the pictures, the projection of an object on the plane may also be missing.

Tones are used to present shading. The shade locates on the objects while images are projected on a plane. Tone shows the direction of lights.

(a) Cone *(b) Sphere* *(c) Cube*

In order to better master the method of shading, the best practice is to observe the projection of basic geometric objects with the changes in the angle of light source.

The shade and the light on an object give a picture a sense of life. Even plane figures can have spacial effect. We may do some practice on projections in the following way.

- Suppose the light source comes from the upper left.
- Emphasise the edges of an object.
- Use clear lines to draw illuminated faces and use thick lines to express backlit faces.
- Use a tone of almost all black to show the location of projection.
- The shadow of an object is presented as a gradual change in layers.
- The position of the reflection of light is left blank.

(iii) Highlighting

Highlights refer to the area of an object that is illuminated by a light source direct. In fact, light's behaviour varies when it falls on different surfaces. For example, it appears in white when reflected from a hard, polished curving surface. On the other hand, it carries some colour of the surface when reflected from a soft, dull, flat surface.

Highlight effects depend on the position of the light sources.

1. Perform Highlighting on a Sphere

There are two steps to perform highlighting on a sphere, which are:

i. On the side where the light source does not reach, draw an arc for the dark surface; and	*ii. Smooth transition of darkness from black to white to perform highlighting.*

2. Using Two Light Sources to Perform Highlighting

There may be light from more than one source falling on an object. The primary and secondary light sources differ in drawing or painting.

The light source of the strongest intensity or that is the closest to the object concerned is called the primary source. It becomes darker and clearer shapes in the shading areas.

On the other hand, the secondary source forms weaker, lighter and softer edged shapes in the shading areas.

An object illuminated by two light sources

4. Interactive Information

	Websites	Content	Language
1	http://tds.ic.polyu.edu.hk/ds/db/08_pd1/index.htm The design process	Introduction to the steps of the design process of products.	Chinese
2	http://zh.wikipedia.org/wiki/%E8%A8%AD%E8%A8%88%E9%81%8B%E5%8B%95	Search for relevant information about design movements through Wikipedia.	Chinese
3	http://baike.baidu.com/search?word=%C9%E8%BC%C6%D4%CB%B6%AF	Search for relevant information about design movements through Baidu.	Simplified Chinese
4	http://resources.hkedcity.net/resource_detail.php?rid=2106037349	Skills in colouring and shading of product design graphics, by St. Joan of Arc Secondary School.	Chinese

5. Glossary of terms

Design movements	設計運動	Sketch	草圖
Arts and Craft	藝術與工藝	Freehand	徒手
Art Nouveau	新藝術	Orthographic projection	正投影
Art Deco Art Decoratifs	裝飾藝術	Orthographic drawing	正投影圖
De Stijl	風格派	Isometric drawing	等角投影圖
Bauhaus	包浩斯	Perspective drawing	透視圖
Modernism	現代主義	Oblique drawing	斜視圖
Pop Art	普普藝術/ 波普藝術	Vanishing point	消失點
Cubism	立體主義	First angle projection	第一角投影法
Memphis	孟菲斯	Third angle projection	第三角投影法
Post-modernism	後現代主義	Elevation	正視圖
		End view/ End elevation	側視圖/端視圖
		Plan	俯視圖/平面圖

Lesson Exercise:

1. The two-point perspective concept diagram of RTHK New Broadcasting House is shown below.
   i. Find its two vanishing points from the concept diagram.

   ii. Complete the two-point perspective drawing for the building below.。

2. Each of the following objects (shown as the third angle projection) misses one or more of its views. Find the correct views on the right and write down the answers in the corresponding space provided.

3. The following are the two orthographic drawings of a toy. Take Z as the lowest point, draw its isometric drawing.

4. Use the thick and thin lines to improve the presentation effect of the following objects.

a

b

c

d

e

5. Fill in the following solids with appropriate tones. The upper face of the each solid is the brightest. The left side is darker and the right side is the darkest.

a.

Light source

b

Light source

c. *Light source*

d

Light source

e.

Light source

6a. Follow the steps described in the teaching materials and draw the following vacuum flask in the space provided on the right.。

6b. Referring to the figure below, (fix the light source first) add highlight effects to the vacuum flask drawn so as to strengthen the 3D-effect.

7. In an appropriate ratio, draw freehand the following cup in the space provided on the right. Add highlight effects after fixing the light source so as to strengthen the 3D-effect.

8. On the isometric grid below, design a set of jungle gym for ABC Kindergarten. (It is necessary to strengthen the 3D-effect.)

Example 1:

Example 2:

Project Exercise-Projection Views

This exercise in orthographic drawing is arranged according to level of difficulty. Teachers may use it for classwork, homework or tests.

In the latter part of the exercise in orthographic drawing, no grids are provided and more drawing tools are required.

Students should follow the instructions from teachers to complete the exercise freehand or using appropriate drawing tools.

Example 1 Square Prism

The figure below shows a gift. In fact, it is a simple square prism.

(a) An example of a square prism

(b) A simple square prism

The figure below shows the orthographic projection and the isometric drawing of the gift (square prism).

(a) Orthographic projection of the square prism

(b) Isometric drawing of the square prism

Without the aid of grids, complete the isometric drawing of the square prism freehand.

Example 2 Triangular Prism

The figure below shows an example of a triangular prism.

An example of a triangular prism

The figure below shows the orthographic projection and the isometric drawing of the triangular prism.

(a) Orthographic projection of the triangular prism

(b) Isometric drawing of the triangular prism

Without the aid of grids, complete the isometric drawing of the triangular prism freehand.

Example 3 Hexagonal Prism

The figure below shows an example of a hexagonal prism.

An example of a hexagonal prism

The figure below shows the orthographic projection and the isometric drawing of the hexagonal prism.

(a) Orthographic projection of the hexagonal prism

(b) Isometric drawing of the hexagonal prism

Without the aid of grids, complete the isometric drawing of the hexagonal prism freehand.

(i) Exercise on Orthographic Projection on Grids:

According to each of the following isometric drawings, draw on the right its elevation (the direction of the arrow), end view and plan using the third angle projection.

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6
7
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24

(ii) Exercise on Orthographic Projection:

1. The figure at 15-mm intervals on the right is the isometric drawing of a frame. In the appropriate spaces below, draw the elevation (from the direction of the arrow), the end view and the plan of the frame using the third angle projection.

Plan

End view

Elevation

2. The figure at 15-mm intervals on the right is the isometric drawing of a frame. In the appropriate spaces below, draw the elevation (from the direction of the arrow), the end view and the plan of the frame using the third angle projection.

Plan

End view

Elevation

3. The figure at 15-mm intervals on the right is the isometric drawing of a frame. In the appropriate spaces below, draw the elevation (from the direction of the arrow), the end view and the plan of the frame using the third angle projection.

Plan

End view

Elevation

4. The figure at 15-mm intervals on the right is the isometric drawing of a frame. In the appropriate spaces below, draw the elevation (from the direction of the arrow), the end view and the plan of the frame using the third angle projection.

Plan

End view

Elevation

5. The figure at 15-mm intervals on the right is the isometric drawing of a frame. In the appropriate spaces below, draw the elevation (from the direction of the arrow), the end view and the plan of the frame using the third angle projection.

Plan

End view

Elevation

6. The figure on the right is the photo of a try square for drawing lines. Rotate it in a suitable direction. Draw its elevation, end view and plan using the third angle projection in the appropriate spaces below.

Plan

End view

Elevation

7. In the box on the right, stick or draw a 3D object near you (e.g. a desk and a chair). Draw its elevation, end view and plan using the third angle projection in the appropriate spaces below.

Plan

End view

Elevation

Project Activity - Design Process and Consideration
(Commemorative Stationery Organiser)

Project Activity Guidelines

1. Objectives

Students have a basic understanding about design styles, design procedures and the safety usage of hand tools and bench type machines. Use appropriate communication skills to express design ideas and use appropriate hand tools and bench type machines to make products.

2. On completion of the project activity, students should be able to

1. make use of communication skills to express design ideas;
2. select design styles; and
3. use hand tools and bench type machines to make the products.

3. Situation

When there are important things to do, we use a pencil to jot things down on paper and place it on the desk. But, there is sometimes no pencil, paper or notepaper at hand, or it is occasionally covered by books or other items.

Design and make a commemorative stationery organizer for friends as a souvenir and to solve the above problems.

4. Design Brief

Design and make a commemorative stationery organizer with the use of design style so that it can be put on the desk for keeping paper and pencil in case we need to jot down notes.

5. Recommended Time

8 teaching periods × 40 minutes (total 320 minutes)

6. Materials Required

(i) Plywood: 150mm (length) × 100mm (width) × 5mm (thick) One piece

(ii) Environmental Plastic Board: 150mm (length) × 100mm (width) × 3mm (thick)
Two pieces of different colours

7. Activity Content

(i) Considerations

The following questions should be considered in designing and making the commemorative stationery organiser:

(i) What is the shape of the base?

(ii) What stationery will be used? How to keep it?

(iii) What notepaper will be used? How to keep it?

(iv) What are the properties of the materials provided?

(v) How to use the materials provided properly?

(vi) What method to be used to make the units for keeping the stationery and notepaper?

(vii) What additional devices/functions can be added?

(viii) What method to be used to join the base and each of the units?

(ix) How to easily get the stationery and notepaper?

(x) What method to be used for surface finishing?

(ii) Design folio

The design folio may include the following items in order to record the design process.

(i) Cover
(ii) Table of contents
(iii) Situation
(iv) Design brief
(v) Design specifications
(vi) Data collection
(vii) Proposed solutions
It is necessary to include the freehand sketches of the development of the design ideas and a brief written explanation about the development of the ideas, and the elevation, end view and plan of the final design using orthographic projection,
(viii) Realisation (pictures can be used to record part of the production process)
(ix) Testing
(x) Evaluation

The design folio may also include:

My design is similar to those of the design movement _____introduced in the Relevant Knowledge.

Describe with no less than 30 words about how you apply the idea of design movements in your design:

_____

_____

_____

References:

Basic Design of Stationery Organiser:

Branded wooden stationery unit

Plastic stationery unit with a mirror and a photo frame

Using a ceramic cup as a stationery unit

Stationery unit wrapped in leather

***To avoid interfering students' thinking, only stationery units are provided for reference, but not the notepaper or the base.*