



Transforming a School Activity Room into a Café Corner

Imagine transforming an activity room in your school into a comfortable café corner where students and teachers can gather, chat, and relax. How exciting would that be!

Your mission is to act as an interior designer and design this unique café corner. You will use mathematical modelling to plan the arrangement of tables and chairs and prepare a budget report for the cost of the furniture.

This activity not only enhances your creativity but also develops your ability to use mathematical modelling for practical planning and budgeting.

4. Based on the dimension of the activity room and the following existing equipment, create an initial floor plan for the café corner on the next page (or a separate graph paper), thereby presenting the layout arrangement of tables and seating.

The dimensions of the existing equipment are as follows:

- Coffee machine with its desk: 300 cm (L) × 80 cm (W) × 160 cm (H)
- Microwave oven with its desk: 70 cm (L) × 50 cm (W) × 120 cm (H)
- Washing station: 250 cm (L) × 80 cm (W) × 90 cm (H)

Also, discuss the comfort level of the café corner by considering Factors 1 and 2 or other relevant factors.

Factor 1: Passage Width = _____

Factor 2: Free-space Ratio = _____

Other relevant factors:

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Worksheet 2

Activity 2A

Observe variables that affect the café corner design and customer experience through site visits.

1. Visit some nearby café corners or restaurants and take notes on the following aspects.
 - i. The number of customers accommodated at one time.
 - ii. The number of different types of tables available.
 - iii. The passage width and measurement strategy.
 - iv. The free-space ratio and measurement strategy.
 - v. Your perceived “comfort level” as a customer.

Café Corner or Restaurant 1

Name:
Number of customers (max):
Number of different types of tables: <ul style="list-style-type: none">• Tables for 2:• Tables for 4:• Other types of tables:
Passage width: Measurement strategy:
Free-space ratio: Measurement strategy:
Comfort level: (Lowest) 1 / 2 / 3 / 4 / 5 (Highest)

Café Corner or Restaurant 2

Name:
Number of customers (max):
Number of different types of tables: <ul style="list-style-type: none">• Tables for 2:• Tables for 4:• Other types of tables:
Passage width: Measurement strategy:
Free-space ratio: Measurement strategy:
Comfort level: (Lowest) 1 / 2 / 3 / 4 / 5 (Highest)

Café Corner or Restaurant 3

Name:
Number of customers (max):
Number of different types of tables: <ul style="list-style-type: none">• Tables for 2:• Tables for 4:• Other types of tables:
Passage width: Measurement strategy:
Free-space ratio: Measurement strategy:
Comfort level: (Lowest) 1 / 2 / 3 / 4 / 5 (Highest)

Activity 2B

Collect data about the furniture that best suit the school’s new café corner.

3. When collecting data of the furniture for the new café corner, considering the comfort level and budget of the café corner, what data/information would you collect?

4. Visit a nearby furniture store (or browse an online retailer) to collect information on several types of tables and chairs that could be considered for the café corner.

Furniture type 1	Table for ____ / Chair / Others: _____
Brand and product model	
Dimension	
Price	
Comfort level	(Lowest) 1 / 2 / 3 / 4 / 5 (Highest)
Other remarks (or picture)	

Furniture type 2	Table for ____ / Chair / Others: _____
Brand and product model	
Dimension	
Price	
Comfort level	(Lowest) 1 / 2 / 3 / 4 / 5 (Highest)
Other remarks (or picture)	

Furniture type 3	Table for ____ / Chair / Others: _____
Brand and product model	
Dimension	
Price	
Comfort level	(Lowest) 1 / 2 / 3 / 4 / 5 (Highest)
Other remarks (or picture)	

Furniture type 4	Table for ____ / Chair / Others: _____
Brand and product model	
Dimension	
Price	
Comfort level	(Lowest) 1 / 2 / 3 / 4 / 5 (Highest)
Other remarks (or picture)	

Furniture type 5	Table for ____ / Chair / Others: _____
Brand and product model	
Dimension	
Price	
Comfort level	(Lowest) 1 / 2 / 3 / 4 / 5 (Highest)
Other remarks (or picture)	

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Worksheet 3

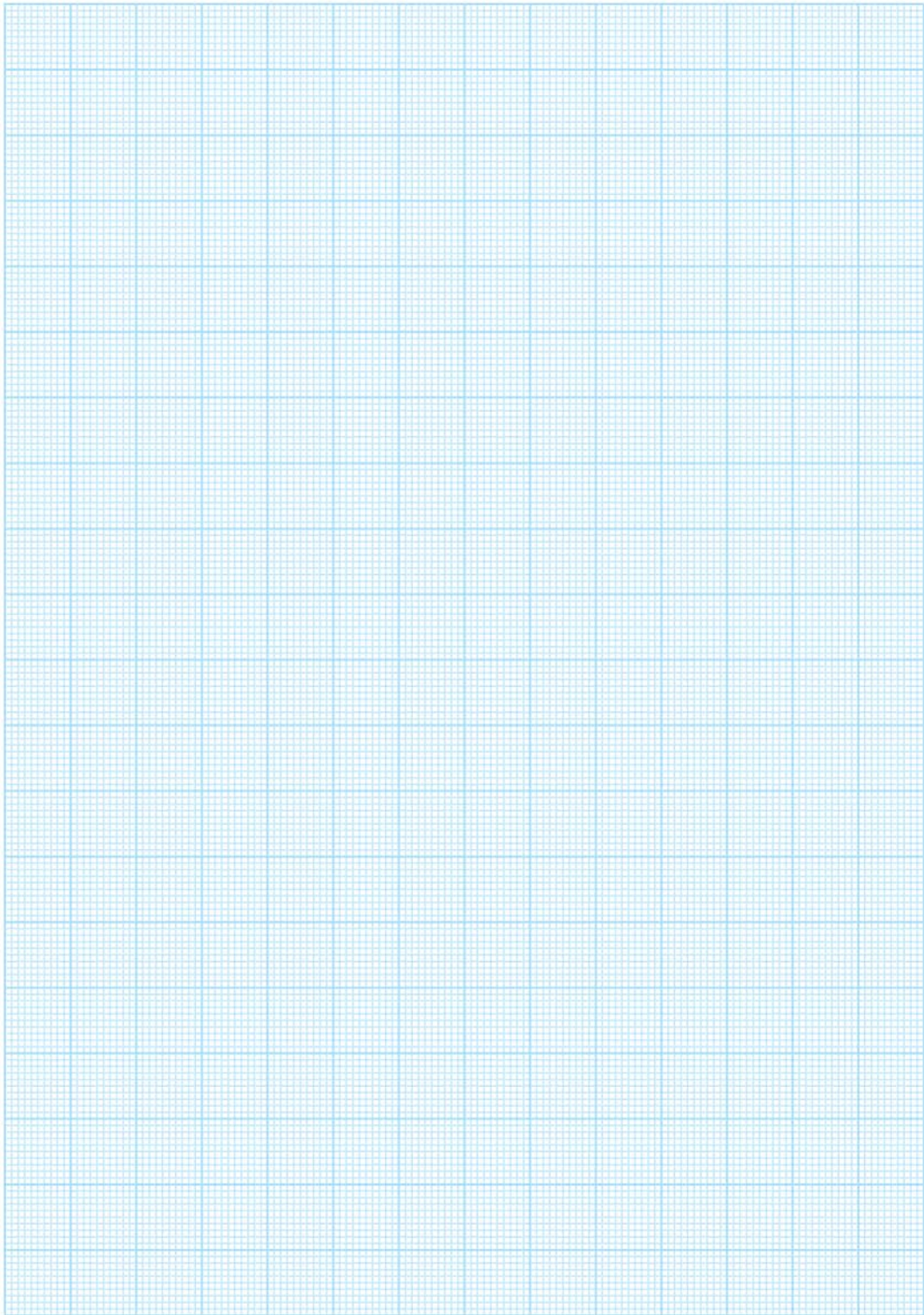
Activity 3

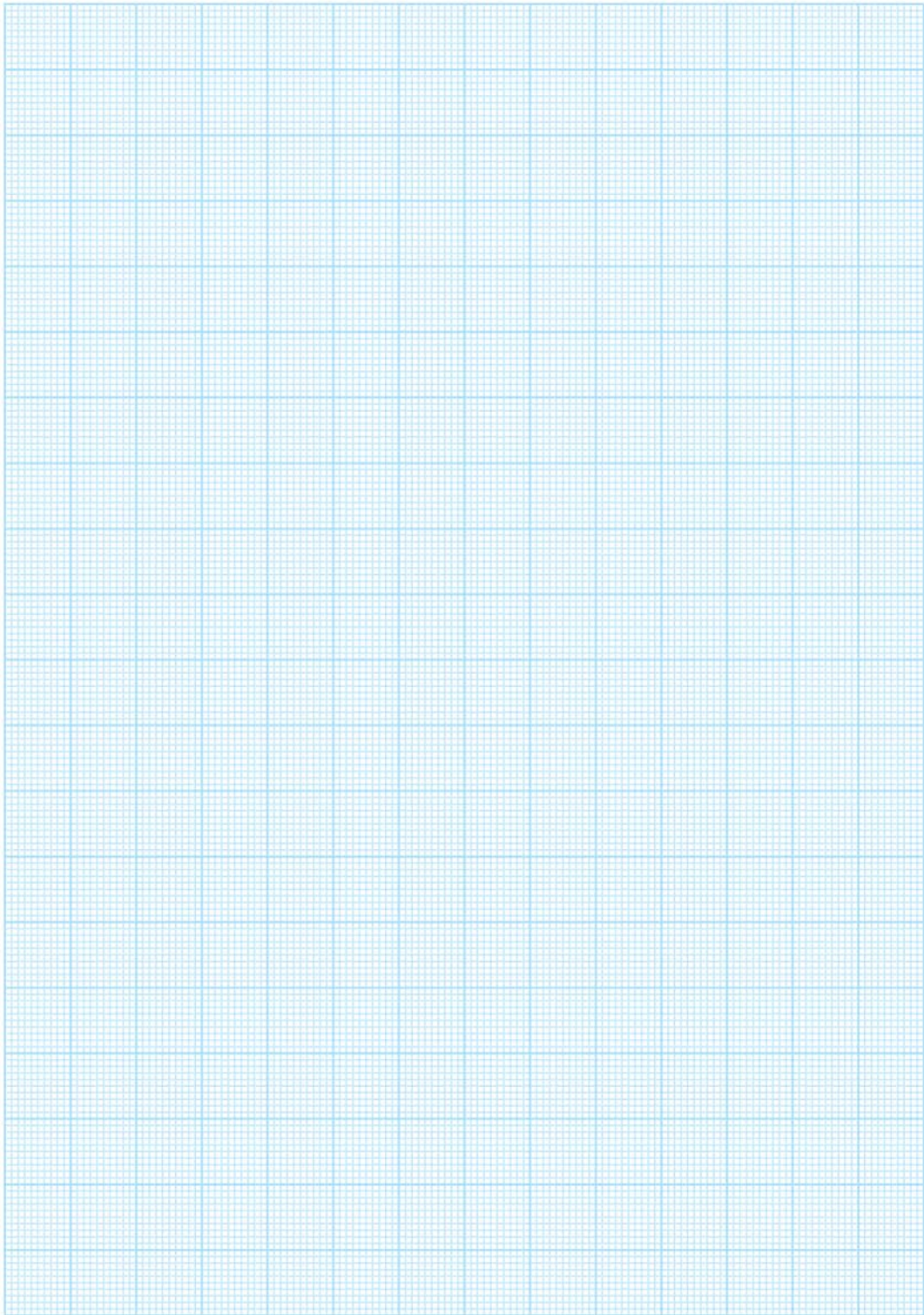
Considering the outcomes from Activity 2 regarding the comfort level of the café corner and the furniture costs, create a refined design for the café corner in the form of a scaled floor plan and establish a budget for the café corner's furnishings. Observe different designs through group presentations and think about how to optimise one's own design.

1. Referring to the following steps, create a scaled floor plan of the café corner on the next page (or a separate graph paper).

Step:

- i. Using the measurements in Activity 1, set the dimensions of the floor plan with a scale (e.g., 1:100) on the graph paper.
- ii. If necessary, discuss whether to change the positions of the existing equipment in the café corner (see Question 4 in Activity 1).
- iii. Based on the observations from Activity 2A, discuss how to arrange the furniture to enhance the comfort level of the café corner while also considering the operational needs of the café corner.
- iv. Based on the data in Activity 2B, decide the types and quantities of tables and chairs that you are going to use.
- v. Draw a scaled floor plan of the café corner that includes the layout of the entrance and furniture.







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Worksheet 1

Activity 1

To describe mathematically the comfort level of a space and create an initial floor plan for the café corner.

1. On the Internet, we often see customer ratings for different restaurants, which typically include the “comfort level” of the restaurant decor. For example:

RATING	Taste	★	★	★	★	★
	Decor	★	★	★	★	☆
	Service	★	★	★	★	☆

Before designing the café corner, propose some factors that might affect the “comfort level” of the café corner. Which of these are related to mathematics?

Factors more directly related to mathematics:

- The size of the café corner
- The number of customers accommodated at one time
- The numbers of tables and chairs
- The distance between two sets of tables and chairs

Factors less directly related to mathematics:

- Background music
- Decoration
- Colours

We will explore two factors that can help quantify the comfort level in a space.

2. Factor 1: Passage Width

- (a) How do you think the passage width can affect the comfort level?
- (b) Based on the current setting of the activity room, measure the passage width between two sets of tables and chairs.

Hence, recommend an optimal passage width suitable for the café corner.

- (c) During site visits, if we quantify the comfort level in a café corner or restaurant using the passage width, what difficulty might we encounter? How can we resolve?

- (a) Generally speaking, the larger the passage width, meaning the more spacious the passage, and the higher the comfort level.
Conversely, the smaller the passage width, meaning the more cramped the passage, and the lower the comfort level.

- (b) [Note: Students can propose a reasonable passage width, such as considering the passage width needed for a person holding a cup of coffee.]

- (c) Difficulty: Typically, there are multiple passages with varying widths in a café corner or restaurant.

Solution: We can formulate strategies to identify the most representative passage width, such as calculating the mean, modal class, or median of all passage widths in the space.

3. Factor 2: Free-space Ratio

We defined the free-space ratio as:

$$\text{Free-space ratio} = \frac{\text{Total area} - \text{Area occupied}}{\text{Total area}}$$

If the activity room is nearly fully occupied by tables, chairs, and equipment (i.e., the area occupied is close to the total area), the free-space ratio will approach 0. Conversely, if very little space in the activity room is occupied by tables, chairs, and equipment (i.e., the area occupied is close to 0), the free-space ratio will approach 1.

- (a) What problems may arise if the free-space ratio is close to 0 or close to 1?
- (b) By measuring the activity room and the area occupied by the furniture inside, calculate the free-space ratio of the current setting.

Hence, recommend an optimal free-space ratio suitable for the café corner.

- (c) During site visits, if we quantify the comfort level in a café corner or restaurant using the free-space ratio, what difficulty might we encounter? How can we resolve?
- (d) What are the limitations regarding the factor of the free-space ratio?

- (a) If the free-space ratio is close to 0, the activity room becomes overcrowded, making customers' movement difficult. Conversely, if the free-space ratio is close to 1, it can result in a feeling of emptiness and underutilisation of the space.
- (b) [Note: Students can refer to the current free-space ratio of the activity room and their perception of it to propose a reasonable free-space ratio for the café corner.]
- (c) Difficulty: Accurately measuring dimensions in an operating café corner or restaurant can be difficult due to the movement of customers and staff within the space.
Solution: We can employ estimation techniques, such as measuring specific areas of the café corner or restaurant and then using these results to estimate the size of the entire space.
- (d) The free-space ratio does not adequately reflect the effect of furniture shape and position or orientation on the comfort level. Besides, the free-space ratio is a 2D indicator and does not fully capture the extent of occupancy in a 3D space.

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Other relevant factors:

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Activity 2A

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Passage width: Measurement strategy:
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Café Corner or Restaurant 3

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Number of customers (max):
Number of different types of tables: <ul style="list-style-type: none">• Tables for 2:• Tables for 4:• Other types of tables:
Passage width: Measurement strategy:
Free-space ratio: Measurement strategy:
Comfort level: (Lowest) 1 / 2 / 3 / 4 / 5 (Highest)

2. Considering your data collected during the site visits, what conditions do you think a comfortable café corner has to fulfil?

How would you refine the values in the design in Activity 1 (Question 4) for Factor 1 (passage width) and Factor 2 (free-space ratio)?

[Examples for reference]

A comfortable café corner has to fulfil the following conditions:

- The number of customers ≤ 30
- The number of tables ≤ 15
- Factor 1: The passage width ≥ 1.5 m
- Factor 2: The free-space ratio ≈ 0.5

Activity 2B

Collect data about the furniture that best suit the school’s new café corner.

3. When collecting data of the furniture for the new café corner, considering the comfort level and budget of the café corner, what data/information would you collect?

[Examples for reference]
Data/information related to the comfort level and budget:

- Dimension
- Function (e.g., the number of people per table)
- Comfort level (e.g., the heights and materials of the tables and chairs)
- Price

4. Visit a nearby furniture store (or browse an online retailer) to collect information on several types of tables and chairs that could be considered for the café corner.

Furniture type 1	Table for ____ / Chair / Others: _____
Brand and product model	
Dimension	
Price	
Comfort level	(Lowest) 1 / 2 / 3 / 4 / 5 (Highest)
Other remarks (or picture)	

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Dimension	
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Brand and product model	
Dimension	
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Brand and product model	
Dimension	
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Other remarks (or picture)	

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Brand and product model	
Dimension	
Price	
Comfort level	(Lowest) 1 / 2 / 3 / 4 / 5 (Highest)
Other remarks (or picture)	

Furniture type 6	Table for ____ / Chair / Others: _____
Brand and product model	
Dimension	
Price	
Comfort level	(Lowest) 1 / 2 / 3 / 4 / 5 (Highest)
Other remarks (or picture)	

5. Based on the collected data, discuss the price ranges of different furniture and estimate the furniture costs based on the initial coffee corner design developed in Activity 1.

[Examples for reference]

A typical small café corner that can provide 15 to 30 seats has a furniture cost of approximately \$120,000 to \$250,000. This includes a corresponding number of tables, chairs, and sofas, with the reference costs for each piece of furniture as follows:

- Chairs/stools: \$800 to \$5,500 each
- Tables (for 2 or 4 people): \$3,000 to \$12,000 each
- Sofas/booths (for 2 to 4 people): \$8,000 to \$25,000 each
- Bar counter (6 to 10 feet): \$30,000 to \$80,000 each

[Note: The teacher and students can discuss the corresponding reasonable furniture costs based on the situation of the school activity room and the requirements of the café corner.]

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Activity 3

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