

# 運用人工智能 進行開放性科學題目評測

2025年 4月

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# 為什麼要進行開放性科學評測？

- 開放性科學題目能有效激發學生的**創意思維**與**科學推理能力**
- 幫助學生從**多角度分析問題**，並發展創意思維：
  - 提出**原創**意念(original ideas)
  - 提出**多元**意念(diverse ideas)
  - 就現行方案進行**評鑑及改良**(Evaluate and Improve solutions)
- 與傳統科學題目相比，**開放性題目沒有既定答案**，並能更有效評估學生的創意和運用科學知識解決科學問題的能力。

# 運用人工智能進行評測的好處

- 人工智能（AI）工具能支援教師更高效地評閱學生多樣和原創的開放性答案。AI 可協助教師：
  - 自動識別學生答案中的核心觀念與推理步驟
  - 根據評分準則進行初步評級並提出具體回饋
  - 協助教師從批次學生答案中快速篩選罕見的答案

# 教師如何應用 AI 工具與資源？

教學設計與評量的應用例子包括：

- **設計具創意挑戰的開放性題目**：設計鼓勵學生提出多樣化方案、比較與優化的題目情境
- **制定清晰的評分準則**：例如就原創性、多樣性方面評鑑答案
- **導入AI自動評閱平台**：使用AI模型進行批改與分析

# 開放性科學課堂活動

## ❶「實驗為本的開放型問題」

例如：就實驗寫出不少於五個控制變項。

## ❷「找不同」

例如：從以下選出與其他不同的項目，運用科學概念說明您的理由：  
氦氣、氫氣、二氧化碳（單元八：原子世界）

## ❸「分類」

例如：把以下項目分成兩個類別，運用科學概念說明您的理由：  
蝙蝠、海豚、鯊魚、鷹（單元二：觀察生物）

## ❹「探索物件的多樣性使用」

例如：寫出五個有關凸透鏡的科學用途。（單元十二：光和聲音）

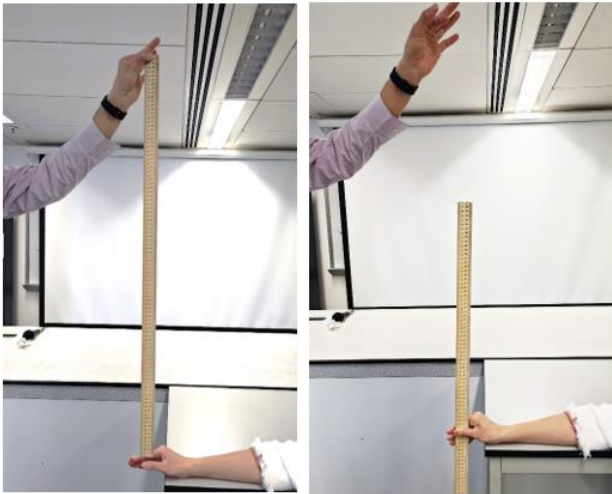
# 操作示例

## 第一部分：制定「實驗為本的開放型問題」

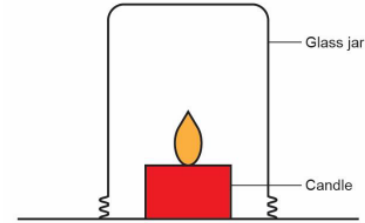
### ① 選擇課程內涉及不同變項的探究活動，例如

Two students are investigating reaction time.

Student A drops a 1m ruler. Student B catches the ruler between her thumb and fingers, as shown in the diagram below. The distance the ruler fell before being caught is recorded.



A student conducted an experiment to investigate the effect of the size of a jar used to cover a lit candle on the time it takes the candle to go out. The experimental setup is shown below:



| Size of glass jar (cm <sup>3</sup> ) | Time for a candle to go out (s) |
|--------------------------------------|---------------------------------|
| 100                                  | 2                               |
| 250                                  | 6                               |
| 500                                  | 10                              |
| 1000                                 | 24                              |
| 2000                                 | 40                              |
| 3000                                 | 58                              |

### ② 設計讓學生提出原創、多樣答案的問題，例如

「盡你所能，寫出進行實驗時需要保持不變的的所有因素。」

# 操作示例

## 第一部分：制定「實驗為本的開放型問題」

### ③ 制定評量標準製作評分表

| <b>Quantity</b><br>數量                               | <b>Diversity</b><br>多樣性                              | <b>Originality</b><br>原創性                                                                      |
|-----------------------------------------------------|------------------------------------------------------|------------------------------------------------------------------------------------------------|
| no. of separate responses<br>答案的數量                  | no. of different approaches<br>答案類別的數目               | the scarcity of response obtained<br>答案的罕見性                                                    |
| @1 mark for<br>each separate response<br>每個獨立回答，得1分 | @1 mark for<br>each different approach<br>每個不同類別，得1分 | @ 2 marks for<br>each response that appears < 5%<br>of the total responses<br>答案出現佔總數目少於5%，得2分 |

# 操作示例

## 第一部分：制定「實驗為本的開放型問題」

### ④ 使用評分表就少量學生答案樣本進行批改，檢視評分表是否需要調整

| Factor                                                                                         |
|------------------------------------------------------------------------------------------------|
| Example : Same size/length ruler                                                               |
| same <del>stop</del> stopwatch / time counting equipment. ①                                    |
| same thickness of the ruler. ②                                                                 |
| same person responsible for counting time. ③                                                   |
| better to be carried out indoors with less effect from wind (turn on / off the fan) (indoor) ④ |
| - location of the experiment ⑤                                                                 |
| room temperature. ⑥                                                                            |
| no. of people in the surrounding environment.                                                  |
| the height to release the ruler by student A (same PE) ⑦                                       |
|                                                                                                |
|                                                                                                |

| Quantity<br>數量 | Diversity<br>多樣性                        | Originality<br>原創性 |
|----------------|-----------------------------------------|--------------------|
| 學生共提出<br>7個答案  | 學生答案可<br>分作3個類別<br>(例如：環境因素、<br>實驗過程因素) | 答案⑤<br>屬罕見答案       |



# 操作示例

## 第二部分：運用AI進行題目評估

① 開啟人工智能聊天機械人，載入科學實驗工作紙及評分準則。



② 輸入以下指令：「寫出進行此實驗時需要保持不變的15個因素，並根據評分準則進行評分。」，然後檢視所生成的答案是否合理。

Two students are investigating reaction time.  
Student A drops a 1m ruler. Student B catches the ruler between her thumb and fingers, as shown in the diagram below. The distance the ruler fell before being caught is recorded.  
Write 15 factors that need to be kept constant when carrying out the experiment.

When investigating reaction time using the ruler drop test, it's important to control variables to ensure accurate and consistent results. Here are **15 factors** that need to be kept constant:

### Environmental & Setup Factors:

1. **Height from which the ruler is dropped** – Must be the same (e.g., always held at 1m).
2. **Position of the catcher's hand** – Should start at the same level (e.g., thumb and fingers at the 0 cm mark).

# 操作示例

## 第二部分：運用AI進行題目評估

③ 掃描學生作業，並上載PDF至AI進行批改。  
(亦可運用線上平台收集學生答案)

|    | Factor                                                                                       |
|----|----------------------------------------------------------------------------------------------|
| 1  | Example : Same size/length ruler                                                             |
|    | Same material                                                                                |
|    | Same timer                                                                                   |
|    | Same thickness                                                                               |
|    | same starting point                                                                          |
|    | Same holding position of two students                                                        |
|    | Same person to use the timer                                                                 |
|    | Factor                                                                                       |
| 1  | Example : Same size/length ruler                                                             |
| 2. | same <del>stop</del> stopwatch / time counting equipment.                                    |
| 3  | same thickness of the ruler.                                                                 |
| 4. | same person responsible for counting time                                                    |
| 5  | better to be carried out indoors with less effect from wind (turn on / off the fan) (indoor) |
|    | - location of the experiment                                                                 |
| 6  | room temperature.                                                                            |
| 7. | no. of people in the surrounding environment.                                                |
| 8. | the height to release the ruler by student A<br>(same PE)                                    |

輸入以下指令：

「以評分準則批改所上載的學生作業，並就以下項目(數量、多樣性、原創性，以及總分)以列表方式輸出。批改時需注意若多個答案意思相近，則合併為一個答案。」



Can you make me a spreadsheet with their answers and markings?

Sure, here's a compact representation of the breakdown in spreadsheet format for the two students' responses and markings:

| Student   | Responses                                                                                                                                                                  | Quantity (Unique Factors) | Diversity (Categories) |
|-----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|------------------------|
| Student 1 | Same material, Same timer, Same thickness, Same starting point, Same holding position, Same person to use timer                                                            | 6                         | 3                      |
| Student 2 | Same stopwatch, Same thickness of the ruler, Same person responsible for counting time, Indoor setting, Room temperature, Surrounding environment, Height to release ruler | 7                         | 4                      |

Let me know if you'd like me to adjust the marks or make any other modifications! 😊

教師需確保AI輔助批改的最終結果經由人工審核

# 樣本評估結果

across the student responses. For those responses that qualify, I'll apply the marking scheme to update originality and total marks.

Here's the recalculated table with the revised scoring:

|  | Your Name | Factor 1                   | Factor 2                | Factor 3               | Factor 4              | Factor 5                 | Factor 6                     |
|--|-----------|----------------------------|-------------------------|------------------------|-----------------------|--------------------------|------------------------------|
|  | Student A | Same material of the ruler | Same starting height    | Same angle of release  | Same observer         | Same gap between fingers | Same release speed           |
|  | Student B | Same stopwatch             | Same ruler thickness    | Same height to release | Same holding method   | Same material of gloves  | Same observer angle          |
|  | Student C | Same measuring device      | Same finger positioning | Same timer             | Same surface texture  | Same thumb gap           | Same surrounding environment |
|  | Student D | Same stopwatch             | Same release height     | Same observer          | Same surface material | Same gap width           | Air resistance               |
|  | Student E | Same material              | Same angle              | Same observer          | Same drop location    | Same handling method     | Same release moment          |
|  | Student F | Same stopwatch             | Same ruler              | Same drop location     | Air resistance        | Same observer            | Indoor/outdoor               |
|  | Student   | Same                       | Same                    | Same                   | Same                  | Same                     | Same                         |

| Quantity | Diversity | Originality | Total Mark |
|----------|-----------|-------------|------------|
| 9        | 5         | 4           | 18         |
| 8        | 5         | 2           | 15         |
| 7        | 4         | 2           | 13         |
| 6        | 3         | 2           | 11         |
| 7        | 4         | 4           | 15         |
| 6        | 3         | 2           | 11         |
| 8        | 4         | 4           | 16         |