

# **AI Won't Learn for You: Reclaiming Memory and Independence Through Metacognition**

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**Evelyn Boey and Fera Ridwan**



# Your Facilitators



**Evelyn Boey**

## *Current Position*

- Head of Centre, Centre for Continuing Professional Development, HELP University, Malaysia

## *Experience in the education sector*

- more than 20 years
- different roles and education sectors (tertiary to primary)
- lecturer, homeroom teacher, subject specialist, Assistant Principal

## *Experience with Cambridge International*

- Accredited Cambridge Programme Leader (CICTL & CIDTL)
- Accredited Cambridge Trainer for Enrichment Courses
- Accredited Cambridge Resource Trainer



**Fera Ridwan**

## *Current Position*

- Head of Professional Development, Cambridge Professional Development Centre ID234, Al-Irsyad Satya Islamic School, Indonesia

## *Experience in the education sector*

- 20 years teaching experience in Australia and Indonesia at secondary and tertiary level (UNSW, Sydney)
- more than 10 years in a teacher development role
- Professional Development Unit has facilitated PD programmes in Indonesia and Cambodia.

## *Experience with Cambridge International*

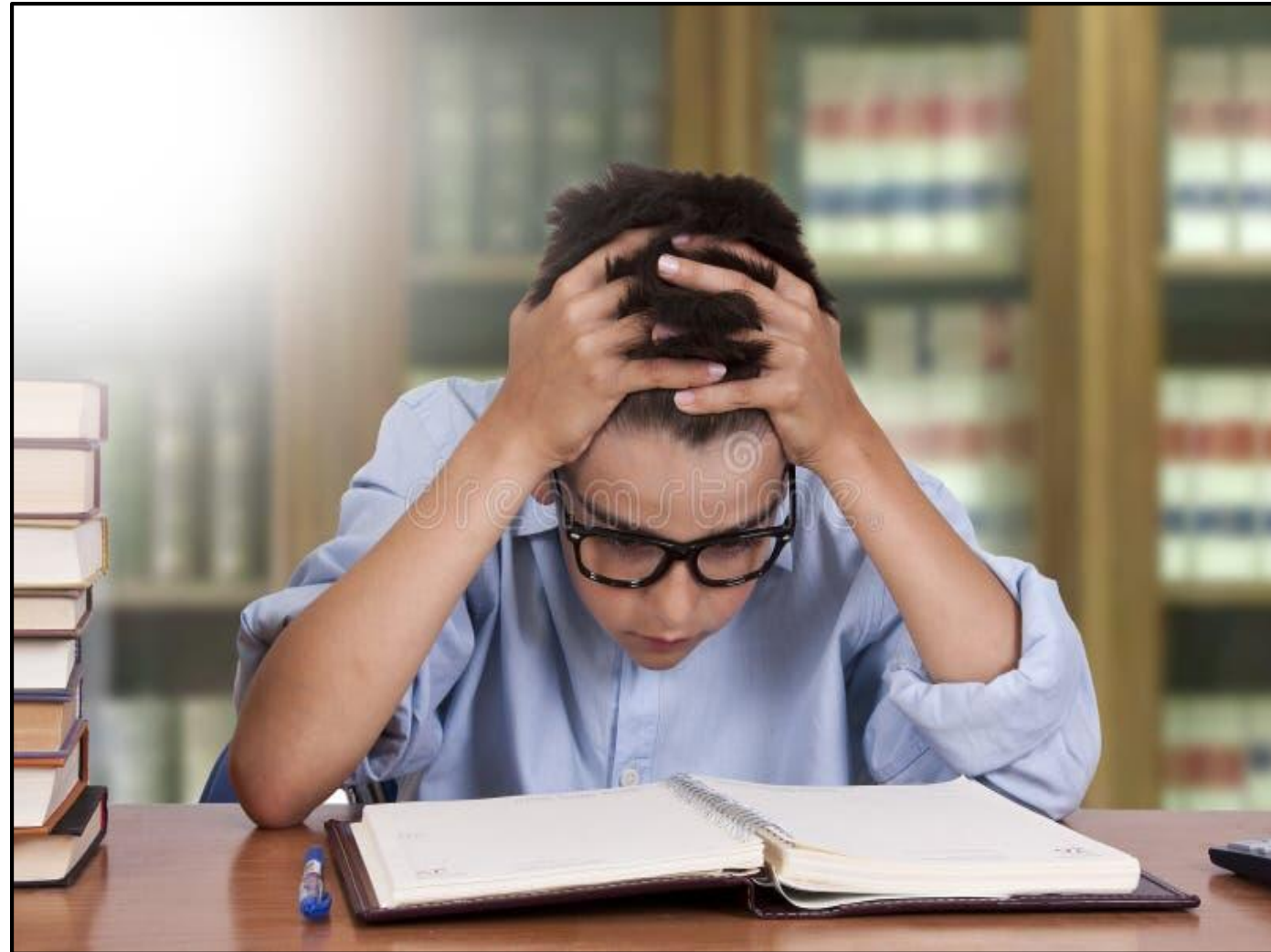
- Accredited Cambridge Programme Leader for CICTL and facilitates CICEdL
- Accredited Cambridge Assessment Trainer and has delivered Cambridge workshops in Indonesia and Malaysia since 2019

# See-Think-Wonder

What do you **see**?

What do you **think** is happening?

What do you **wonder** about the struggle that he is facing?



# By the end of this session, you will ...

gain a deeper understanding of how metacognitive processes enhance memory retention and foster learner independence

examine the role of AI tools in supporting rather than replacing the metacognitive learning process

explore case studies and classroom examples on the use of AI to support metacognition

take away practical teacher prompts to support learners in using AI for metacognitive process.

We need to help learners think harder, remember longer, and stay motivated,  
**EVEN** when AI gives instant answers.



# Think for Yourself!

(Because AI Won't  
Do it For You!)

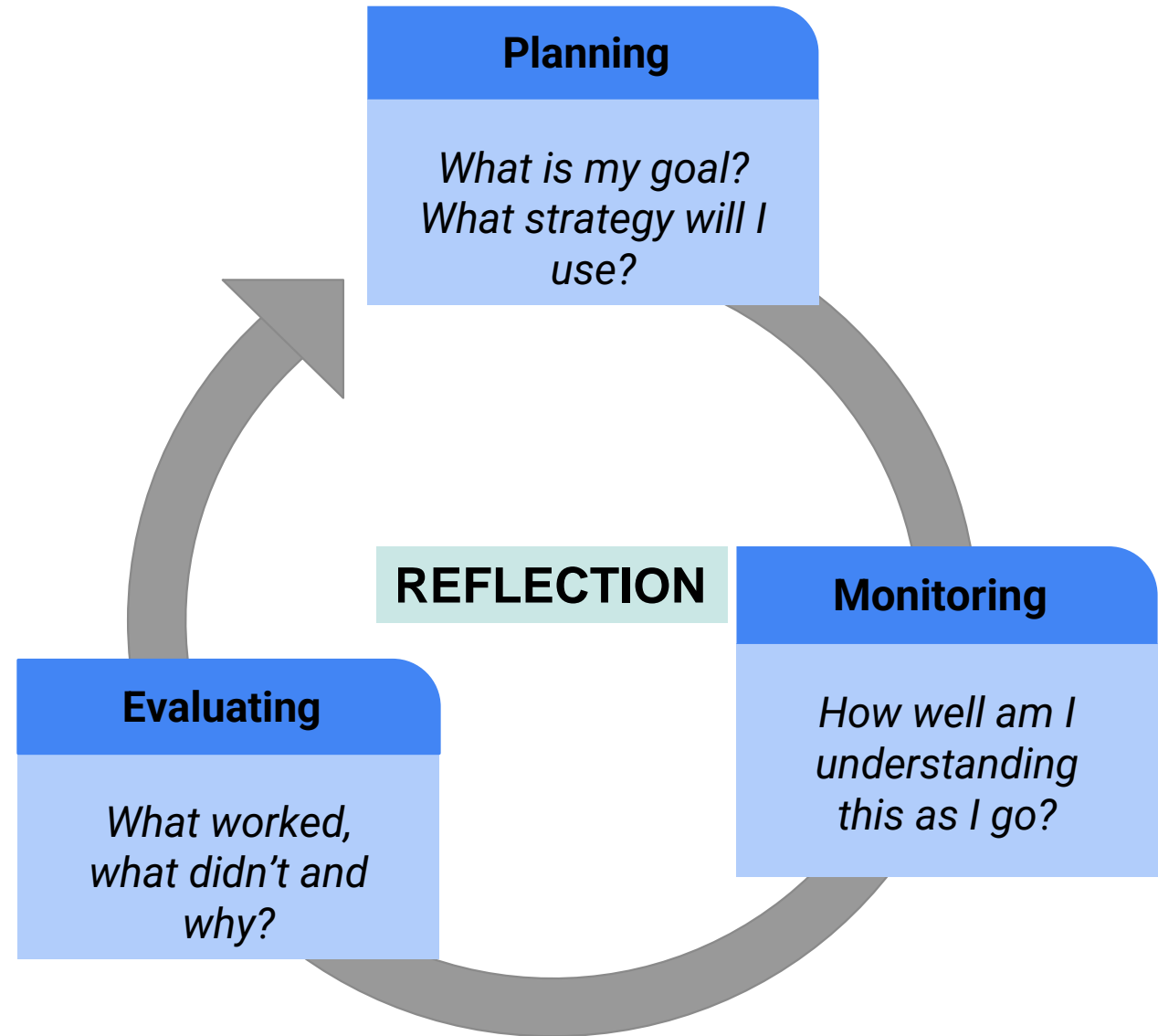


# What is METACOGNITION?

**Metacognition** is  
*thinking about thinking.*

Deep learning is not only “what to learn” but also ***how students think about their learning:***

- being aware of their understanding
- monitoring their thinking
- evaluating their learning
- adjusting their strategies.



## Physics Paper Self-Analysis Sheet: Paper 2C

Name:

Class:

### CODE

MI – my response has missing information and detail

C- I made a calculation/mathematical error

KU– knowledge and understanding (I don't know this content at all)

F – I know this but forgot for the exam.

E – I didn't know the equations for this question.

Q – I don't understand what the question is asking

S – this was a silly mistake. I would have answered this question correctly.

Question Number Eg. Q1(a)i, Q2(b)...	Code Eg. MI, C, KU...	Topic Eg. Stationary Wave, Doppler Effect, Pressure...
Q1(a)	S	Work
Q1(b)	S	SI Unit Derivation
Q1(c)ii	E	Absolute Uncertainty
Q2(b)	E	Weight, Force
Q2(c)ii	F	Velocity-time Graph
Q3(a)	S	Centre of Gravity
Q3(b)ii	C, S	Moment
Q3(b)iii	S	Force (Horizontal Component)
Q4(c)i	MI	Change in Momentum
Q4(c)ii	C	Resultant Force in Impulse
Q4(d)	F	Energy-extension Graph
Q5(a)	F	Stationary Wave
Q5(b)i	KU	Stationary Wave
Q5(c)i	E	Intensity
Q5(c)ii	E	Intensity
Q6(b)	MI, KU	Power in Resistor
Q6(c)iii	E	Internal Resistance
Q7(a)	MI	Structure of Atom
Q7(b)	E, KU	Ratio Charge/Mass
Q7(c)ii	KU	Quark Composition

## CASE STUDY DISCUSSION

Alisha, a Cambridge International AS Level Physics student, had been studying hard for weeks. She reread her notes many times. Yet, when she attempted practice papers, her scores stayed the same.

Frustration began to set in and she couldn't figure out *why* she was still making mistakes. Her motivation dipped, and she started believing that maybe Physics just “wasn't her thing.” She didn't know what to do next.

Her teacher introduced her to a **self-analysis template**, a metacognitive tool that helped her unpack each incorrect response and identify the *type* of error she was making.

*How would this metacognitive tool support Alisha's learning?*



# How does metacognition support self-regulation and student independence?

- **Autonomy:** Students set goals and choose strategies → ownership.
- **Competence:** Monitoring progress shows growth → confidence.
- **Purpose:** Reflecting on learning connects to meaning → persistence.

Self-determination theory (Ryan & Deci, 2000)

Metacognition is the knowledge and regulation of one's own cognitive processes.

- *John Flavell (1979)*

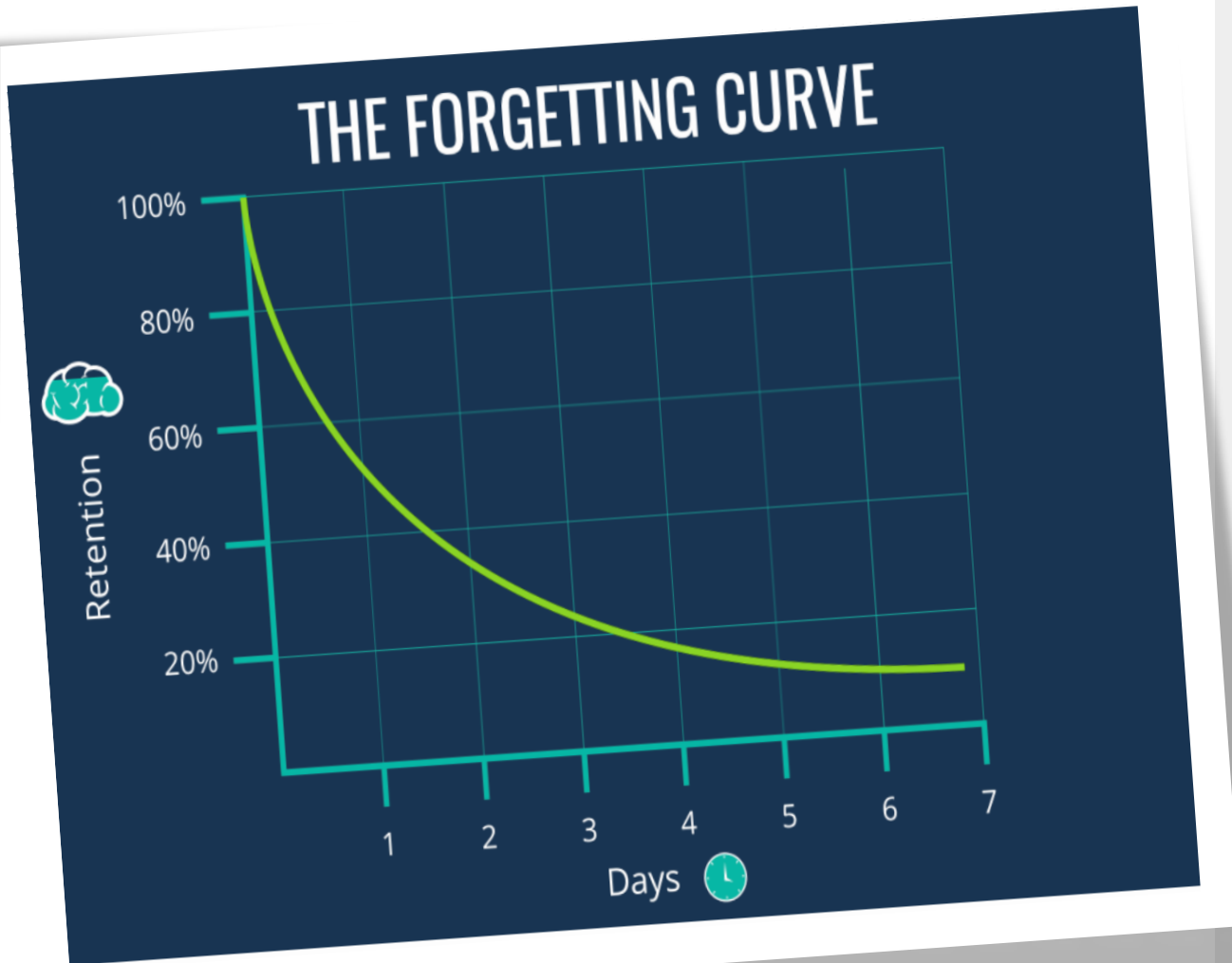
Students who understand *how* they learn can adapt  
when things get hard,  
that's the essence of self-regulation.

# Why can't I remember this?

Memory  
and Metacognition



# The Forgetting Curve



1. Hermann Ebbinghaus, a German psychologist, developed the Forgetting Curve in 1885.
2. It demonstrates how information disappears at an exponential rate when no effort is made to retain it
3. 50 percent of new information disappears within an hour;
4. 75 percent is gone by the next day, and
5. Up to 90 percent fades away within a week.

# ACTIVITY

## - Memory Challenge

1. You need a piece of paper with blank pages on both sides.
2. You will be shown 2 sets of letters.
3. Memorise each, one at a time.
4. Write them down after 10 seconds.



# Starter

XCN

NPH

DFB

IKF

CFI

FAX

X

CNN

PHD

FBI

KFC

FIFA

X

10 seconds

10 seconds

# Starter

XCN

NPH

DFB

IKF

CFI

FAX

X

CNN

PHD

FBI

KFC

FIFA

X

# The Forgetting Curve - Why and Ways to Overcome it

## Factors that influence the retention of memory

- What they're studying
- How much they know going in
- How interested in the material they are or how strongly motivated to learn it
- How the material is taught
- How retention is tested
- When retention is tested

## Ways to Overcome it

- Immediate recall - brain dump
- Repeated, intentional spaced review
- Review - first 24 hours after learning; several times every 2-4 days
- Retrieval practice strategies

# Metacognition can interrupt this curve ...

Metacognitive Phase	How it Combats Forgetting	Example
Planning	Sets Purpose and Context Preparing the brain to remember by providing a purpose	“What’s my goal for this topic?”
Monitoring	Reinforces awareness through self-checking	“Do I really understand this?”
Evaluating	Encourages spaced review and retrieval	“What will I do next to strengthen recall?”

# The AI Era

## Opportunity or Shortcut?





# The AI Era: Opportunity or Shortcut

AI can either:

- **Undermine learning** by removing effort, or
- **Enhance learning** by prompting reflection, feedback, and strategy.

*How can AI support rather than hinder learning that lasts?*

Technology  
amplifies good  
pedagogy, but  
cannot substitute it

- *Lee Shulman (1986)*

# AI Coaching Prompts to Strengthen Memory

Metacognitive Phase	AI Coaching Prompts	How does it Build Thinking?
Planning	<b>Use ChatGPT to generate brainstorm or outline</b> <i>“What do I want to understand better by using AI?”</i> <i>“Can you help me outline steps or questions to guide my learning?”</i>	Encourages intentional planning
Monitoring	<b>Use AI to check understanding</b> <i>“Can you give feedback, not final answers?”</i> <i>“What might I be missing or misunderstanding?”</i>	Build awareness during learning
Evaluating	<b>Ask AI to quiz you and critique your reasoning</b> <i>“How can I check if I really understand this topic?”</i> <i>“What did I do well, and what can I improve next time?”</i>	Reinforces memory through retrieval

“The act of retrieval strengthens memory.  
Metacognition keeps that process alive.”

— *Inspired by Ebbinghaus & Dunlosky, 2013*

# AI as Coach, not Crutch - How do we help students use AI metacognitively?

## Planning

### Goal First

*“What do I want to understand better by using AI?”*

*“Can you help me outline steps or questions to guide my learning?”*

## Monitoring

### AI as Coach

*“Can you give feedback, not final answers?”*

*“What might I be missing or misunderstanding?”*

## Evaluating

### Reflect After Use

*“To what extent have I understood the lesson?”*

*“What did I do well, and what can I improve next time?”*

# A CLASSROOM EXAMPLE

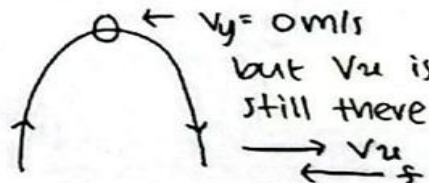
Alex, a Cambridge International AS Level Physics student, had been struggling with multiple-choice questions (MCQs) despite hours of practice. He often made small reasoning or formula mistakes but couldn't pinpoint *why*.

His teacher introduced a structured **AI-supported metacognitive reflection activity** to help him make his thinking visible and learn from his errors.



# A CLASSROOM EXAMPLE

Time	Stage	Description	Prompts / Instructions
5 min	1. Identify and Select	Review a past Paper 1 practice paper you've completed. Highlight <b>3 MCQs they got wrong or guessed.</b>	<ul style="list-style-type: none"><li>• "Which questions made you feel uncertain or stuck?"</li><li>• "What made you choose your original answer?"</li></ul>
10 min	2. Think Aloud (Before AI)	Write your <b>thinking process</b> for each question before consulting AI. The goal is to make your thought process visible.	<ul style="list-style-type: none"><li>• "What was I thinking when I chose that answer?"</li><li>• "What was confusing or misleading?"</li><li>• "What physics principle or formula is involved here?"</li></ul>
10 min	3. AI Consultation (With Guidance)	Use an AI tool (like ChatGPT) to explore the question. <b>Don't ask for the answer directly</b> , but use AI to help you <i>understand</i> their mistake or reasoning gap.	Example AI prompts: <ul style="list-style-type: none"><li>• "I got this MCQ wrong: [paste question]. I thought the answer was B because [explain reasoning]. Can you help me understand where my reasoning went wrong?"</li><li>• "Explain the underlying physics concept for this question in simple terms."</li><li>• "Can you give me a step-by-step reasoning process to approach this kind of question?"</li></ul>
10 min	4. Check Understanding	Use AI to generate similar questions to check for understanding.	Example AI prompts: <ul style="list-style-type: none"><li>• "Generate similar questions to this so that I can check my understanding."</li></ul>
5 min	5. Reflect and Plan	Summarise what you learned and how to approach similar questions in future.	<ul style="list-style-type: none"><li>• "What new insight did I gain from the AI?"</li><li>• "What type of mistake was this (conceptual / calculation / misreading / overthinking)?"</li><li>• "Next time, I will..."</li></ul>

#	Q. No.	My Original Answer	Correct Answer	What I Was Thinking (Before AI)	What the AI Helped Me Realise	Type of Error	My Strategy for Next Time
1	1	A	D	I thought physical quantity is the same like SI Base units.	Metre is a unit, not a quantity. Examples of Physical quantity: > Force > energy > speed > spring constant > Length > Temperature	<input type="checkbox"/> Concept <input type="checkbox"/> Formula <input type="checkbox"/> Misread <input checked="" type="checkbox"/> Guess	Know the difference between physical quantity and units.
2	6	D	C	I used the the vector formula: $V = U + at$	In projectile motion, horizontal and vertical components are independent, and total speed must be calculated vectorially. $V_y = 9.81 \times 3 = 29.4 \text{ m/s}$ $V = \sqrt{(10)^2 + (29.4)^2}$ $= 31 \text{ m/s}$	<input type="checkbox"/> Concept <input checked="" type="checkbox"/> Formula <input type="checkbox"/> Misread <input type="checkbox"/> Guess	Practice how to find speed in vertical and horizontal component.  vertical = use accelerated motion formula. horizontal: $v = \frac{d}{t}$
3	9	C	B	I thought of the motion not the forces.	 <p>so frictional force is present and weight still apply.</p>	<input checked="" type="checkbox"/> Concept <input type="checkbox"/> Formula <input type="checkbox"/> Misread <input type="checkbox"/> Guess	Understand that during maximum height, $V_y$ is 0 m/s but $V_x$ is still moving.

# SAMPLE AI OUTPUT

I got this MCQ wrong. I thought the answer was A because i was thinking of the  $(\text{output}/\text{input}) \times 100\%$  formula, so i put Q as a output and E as an Input. Can you help me understand where my reasoning went wrong?

That's a great question — and it's awesome that you're thinking carefully about *why* you got it wrong, not just memorizing formulas 🧠

Let's go step by step together:

## 1 The question

The total energy supplied to an electric motor is E.  
Energy Q is wasted and the remaining energy does useful work.  
What is the efficiency of the motor?

## 2 Recall the efficiency formula

$$\text{Efficiency} = \frac{\text{useful output energy}}{\text{total input energy}}$$

## 3 Identify input and output

- Input energy = total energy supplied = E
- Wasted energy = Q
- Therefore, useful output energy = total input – wasted energy = E – Q

## 4 Substitute into the formula

$$\text{Efficiency} = \frac{\text{useful output}}{\text{input}} = \frac{E - Q}{E}$$

## 5 Why your reasoning (picking A) went wrong

You correctly used the formula

$$\text{Efficiency} = \frac{\text{output}}{\text{input}}$$

but you mistook what counts as output.

You put Q as the output — but the problem said Q is wasted (that's *energy lost*, not useful output).  
The *useful output* is the *remaining* energy, E – Q.

So you had the right formula, just mixed up which energy represents what 💡



Generate similar questions to this so that i can check my understanding

Perfect mindset, Nori 🌟—practicing with similar-style questions is *exactly* how you lock in the concept! Here are several questions like that (in the same AS Physics style). I'll mix in some different wordings but they all test the same reasoning about **energy, waste, and efficiency** 📌

### ⚡ Question 1

A heater is supplied with **energy** = 2000 J.

It wastes **400 J** to the surroundings.

What is its efficiency?

- A. 0.2
- B. 0.8
- C. 1.2
- D.  $\frac{400}{2000}$

### ⚡ Question 2

The total electrical energy supplied to a motor is **E**.

Energy **W** is wasted as heat.

What is the efficiency of the motor?

- A.  $\frac{W}{E}$
- B.  $\frac{E-W}{E}$
- C.  $1 - \frac{E}{W}$
- D.  $\frac{1}{E-W}$

### ⚡ Question 3

A lamp converts **60 J** of electrical energy into light and **40 J** into heat.

What is the efficiency for producing light?



i got this answer wrong, how i do it is: intensity = amplitude^2, if I = 1, a = 2, if I = 1/2, a = 2, can u tell me where my reasoning is wrong

Ah, I see exactly what happened here, Mei 💡 — your *concept* ("intensity  $\propto$  amplitude<sup>2</sup>") is absolutely correct, but the *way you applied it* had a small mix-up. Let's go through it carefully step by step.

### 🧠 Step 1: Recall the correct relationship

$$I \propto A^2$$

That means if the **intensity** changes, the **amplitude** changes according to:

$$\frac{I_2}{I_1} = \left( \frac{A_2}{A_1} \right)^2$$

### 💬 Step 4: Which graph fits that?

From the image:

- A → same frequency but smaller amplitude? (No, A seems to have *higher* frequency.)
- B → same frequency but only one oscillation (period too long).
- C → same frequency but *half* the amplitude (too small).
- D → same frequency and amplitude slightly smaller than the original ✅

So the correct answer is D.

### ❤️ Summary of where your reasoning slipped

You correctly wrote:

"Intensity = amplitude<sup>2</sup>"

But when you halved intensity, you assumed the amplitude also halved.

In reality, halving intensity only reduces amplitude by a factor of  $\sqrt{1/2} \approx 0.707$ .

# SAMPLE AI OUTPUT

In this question, I chose  $c$  as it had a total of  $E$  always equaling one, and as the small  $v$  decreased the large  $V$  increased, but it seems i got it the logic wrong.

Nice — you're on the right track conceptually, but let's go step by step carefully.

oh, i see. As both started with same  $r$ , both would have had the same  $V$  to start with right?

—

Can you generate similar questions to test my understanding of this particular topic?

Absolutely 👍 — here are a few **practice questions** on **internal resistance**, **e.m.f.**, and **potential division** just like the one you showed. I'll give them in mixed styles (multiple choice + short calculation).



# AI as Coach, not Crutch

Metacognitive Phase	AI Coaching Prompts	How does it Build Thinking?	Risk if used as Crutch
Planning	Use ChatGPT to generate brainstorm or outline  <i>“What do I want to understand better by using AI?”</i> <i>“Can you help me outline steps or questions to guide my learning?”</i>	Encourages intentional planning	<b>Learners skip planning themselves and let AI decide on the entire plan</b>
Monitoring	Use AI to check understanding  <i>“Can you give feedback, not final answers?”</i> <i>“What might I be missing or misunderstanding?”</i>	Build awareness during learning	<b>Learners outsource sense-making; use AI to give the full answer</b>
Evaluating	Ask AI to quiz you and critique your reasoning  <i>“How can I check if I really understand this topic?”</i> <i>“What did I do well, and what can I improve next time?”</i>	Reinforces memory through retrieval	<b>Learners depend on AI’s judgment, not their own</b>

# AI Prompt Bank

**MODEL** how to provide the right AI prompts to support in planning, monitoring and evaluating

Metacognition	Description
<b>Understanding my Mistake</b>	<ul style="list-style-type: none"><li>• I got this question wrong: [paste question or task]. I chose/did [your response] because [explain your reasoning]. Can you help me understand where my reasoning went wrong?</li><li>• Can you explain the difference between my reasoning and the correct reasoning?</li></ul>
<b>Clarifying Concepts</b>	<ul style="list-style-type: none"><li>• What is the main principle or idea behind this question or task?</li><li>• Can you give me a real-life example or analogy to help me understand this better?</li><li>• What are common misconceptions students have about this topic?</li></ul>
<b>Building Transfer and Reflection</b>	<ul style="list-style-type: none"><li>• What patterns do you notice in the kinds of mistakes I'm making?</li><li>• What types of tasks or questions do I usually struggle with?</li><li>• Based on my errors, what should I review or practise next?</li></ul>

# THINK/PAIR/SHARE

Design an activity which supports student metacognition in your classroom using AI.

Planning

Goal First

*“What do I want to understand better by using AI?”*

*“Can you help me outline steps or questions to guide my learning?”*

Monitoring

AI as Coach

*“Can you give feedback, not final answers?”*

*“What might I be missing or misunderstanding?”*

Evaluating

Reflect After Use

*“To what extent have I understood the lesson?”*

*“What did I do well, and what can I improve next time?”*

## Activity: Think Pair Share [EXAMPLE]

Design an activity which supports student metacognition in your classroom using AI.

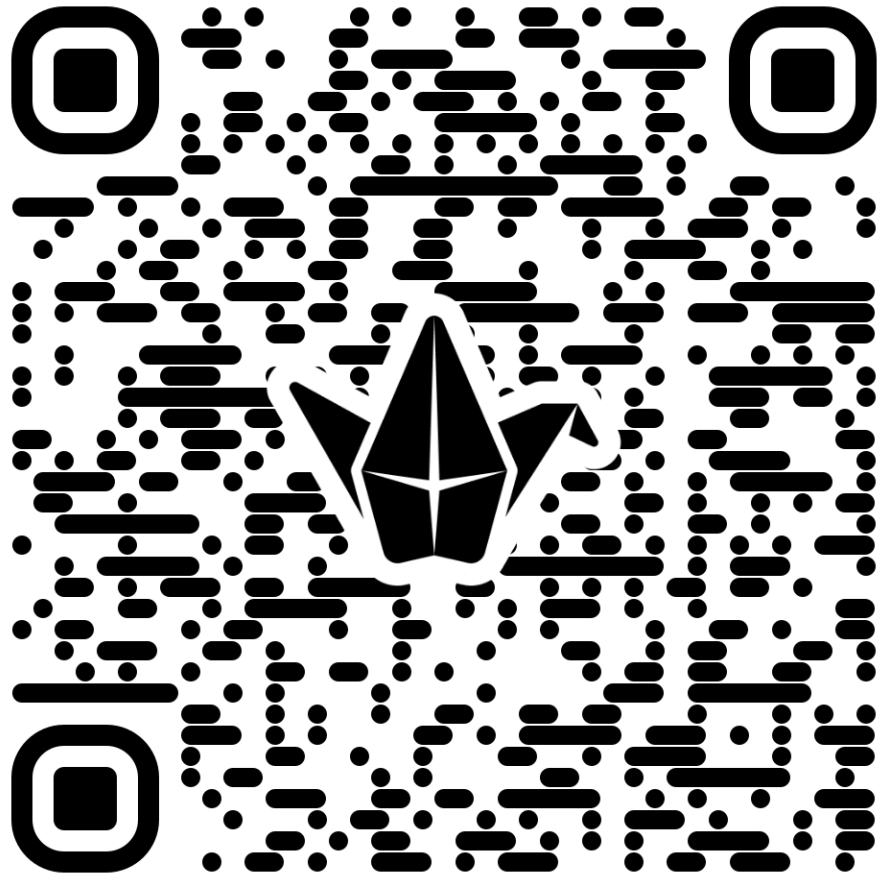
Subject and Grade Level: Grade 9/English
Learning Objective: Students will be able to write a reflective paragraph that clearly expresses personal learning experiences and uses appropriate tone, structure, and coherence
Metacognitive Focus: Which metacognitive stage(s) will your activity support? (tick all that apply) <input checked="" type="checkbox"/> Planning – Helping students plan how they will approach learning <input checked="" type="checkbox"/> Monitoring – Helping students check their progress and understanding <input checked="" type="checkbox"/> Evaluating – Helping students reflect on their learning and outcomes
Brief Description of Activity Students are asked to write a short reflection on a recent group project.  <ol style="list-style-type: none"><li><b>Planning:</b> Before writing, they use AI to brainstorm ideas and generate an outline by asking questions about tone, structure, and focus.</li><li><b>Writing:</b> As they draft, students check with AI whether their introduction and main idea are clear and logically connected.</li><li><b>Evaluation:</b> After completing the paragraph, they ask AI to give feedback on coherence, clarity, and reflection depth—without rewriting the text for them.</li><li>Students then highlight how they used AI feedback to improve their own writing and explain their revision choices in a short reflection logs</li></ol>
What support AI prompts would be suitable for your metacognitive activity? For Planning: <ul style="list-style-type: none"><li>“What should I include in a reflective paragraph about a learning experience?”</li><li>“Can you help me organize my ideas so the reflection has a clear focus?”</li></ul> For Monitoring: <ul style="list-style-type: none"><li>“Is my paragraph clear so far? What part might confuse a reader?”</li><li>“Can you point out where my ideas stop connecting smoothly?”</li></ul> For Evaluating: <ul style="list-style-type: none"><li>“Does my reflection show how I learned, not just what I did?”</li><li>“What could make my writing more thoughtful or meaningful?”</li></ul>
What kind of metacognitive responses or reflections do you expect from students?  “I realized my reflection was only describing events, not explaining my learning.” “I learned to ask AI questions that make me think deeper instead of just fixing grammar.”

# In Conclusion...

**Metacognition** slows the forgetting curve by encouraging active retrieval, reflection, and self-questioning.

**AI** can act as a coach by prompting metacognitive thinking, not providing instant answers.

**Teachers** empower independence by modelling how to plan, monitor, and evaluate learning in an AI-rich world.



## EXIT PASS PADLET

Please share key  
takeaways from this  
session.

**Any  
Questions?**

*Metacognition builds  
awareness, memory builds  
understanding, and  
independence emerges  
when learners, not AI,  
steer both.*

# Thank-you

**Fera Ridwan**

[fera.spo@alirsyadsatya.sch.id](mailto:fera.spo@alirsyadsatya.sch.id)

**Evelyn Boey**

[lkboey04@gmail.com](mailto:lkboey04@gmail.com)

X: @evelynboey

LinkedIn: Evelyn Boey

