



KonPPI-5

Konvensyen Penyelidikan | PLC | Inovasi | KIK
Program Matrikulasi Kementerian Pendidikan **2025**



KEMENTERIAN PENDIDIKAN
BAHAGIAN MATRIKULASI

**Reformasi Pendidikan;
Membangun Generasi Digital,
Mengukuh Masa Hadapan**

Penyelidikan

**AI-POWERED TUTORING
FOR CONCEPTUAL CLARITY
IN ENERGY AND MOMENTUM
AMONG SARAWAK MATRICULATION COLLEGE
PHYSICS STUDENTS**

Kumpulan Solus Sum (KMSw)

Shafiq Rasulan



Penaja

YGTHO
YAYASAN GURU TUN HUSSIEN ONN

Swiss Avenue Hotel , Sungai Petani, Kedah

10-12 Ogos 2025

Anjuran Bersama: Bahagian Matrikulasi
dan Kolej Matrikulasi Pulau Pinang

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MATRIKULASI MEWARNAI
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PERSISTENT MISCONCEPTIONS

“ENERGY IS CONSUMED”
“MOMENTUM = MASS”
“MOMENTUM = FORCE”



PROPOSED SOLUTION

**AI-POWERED TUTORING (CHATGPT/GEMINI/DEEPMSEEK)
FOR PERSONALIZED, LOW-STAKES CONCEPTUAL
FEEDBACK.**

IMPACT

- **HINDERS ANALYSIS OF PHYSICAL SYSTEMS**
- **LOWERS SCORES**
- **REDUCES MOTIVATION.**

DIAGNOSTIC DATA

- IDENTIFYING CONSERVATION OF MOMENTUM (56.67%)
- IMPULSE-MOMENTUM THEOREM (53.33%)
- CONSERVATION OF MECHANICAL ENERGY (42.78%)

INSIGHTS

- *A need for scalable, dialogue-based support in learning.*
- *AI offer real-time, Socratic help that deepens understanding.*
- *Students admit they can memorize but struggle to explain, or fear in discussions.*
- *That's why we need low-pressure spaces for exploring ideas and AI can help create those, addressing misconceptions as they come up.*

STUDENT VOICES

"I MEMORIZED FORMULAS BUT COULDN'T EXPLAIN WHY PHENOMENA OCCUR"

"I UNDERSTAND UNTIL I TRY TO EXPLAIN"

"PEER DISCUSSIONS HELP BUT I FEAR WRONG ANSWERS"



RESEARCH FOCUS



Student challenges identified by assessments

Timing and AI tool integration

Foundational concepts for examination

Core challenges in energy & momentum

Conceptual Difficulties in Physics



Relevance



Feasibility



Importance



Conceptual Difficulties



ACTION OBJECTIVES

Improve students' conceptual understanding of energy and momentum through the integration of AI dialogue-based tutoring tool of energy and momentum through the integration of AI dialogue-based tutoring tool



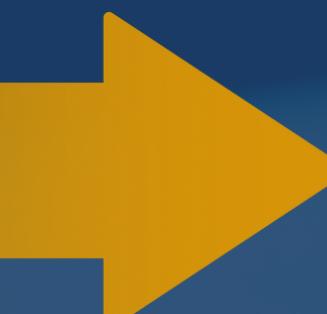
RESEARCH OBJECTIVES

QUANTITATIVE:

- Assess AI efficacy via Energy-Momentum Conceptual Survey (EMCS).
- Investigate learner experiences (Likert-scale feedback).



Target Group



30 KMSW STUDENTS
BASED ON EARLY
DIAGNOSTIC DATA

AI-POWERED TUTORING
BY SHAFIQ R



SOCRATIC QUESTIONING FOR SELF-INQUIRY.

How to ask
a good question?

PRE-INTERVENTION TRAINING

How to recognize **EVALUATE AI RESPONSES.**
good answer?

AI-POWERED TUTORING
BY SHAFIQ R

AI-Mediated Learning Cycle

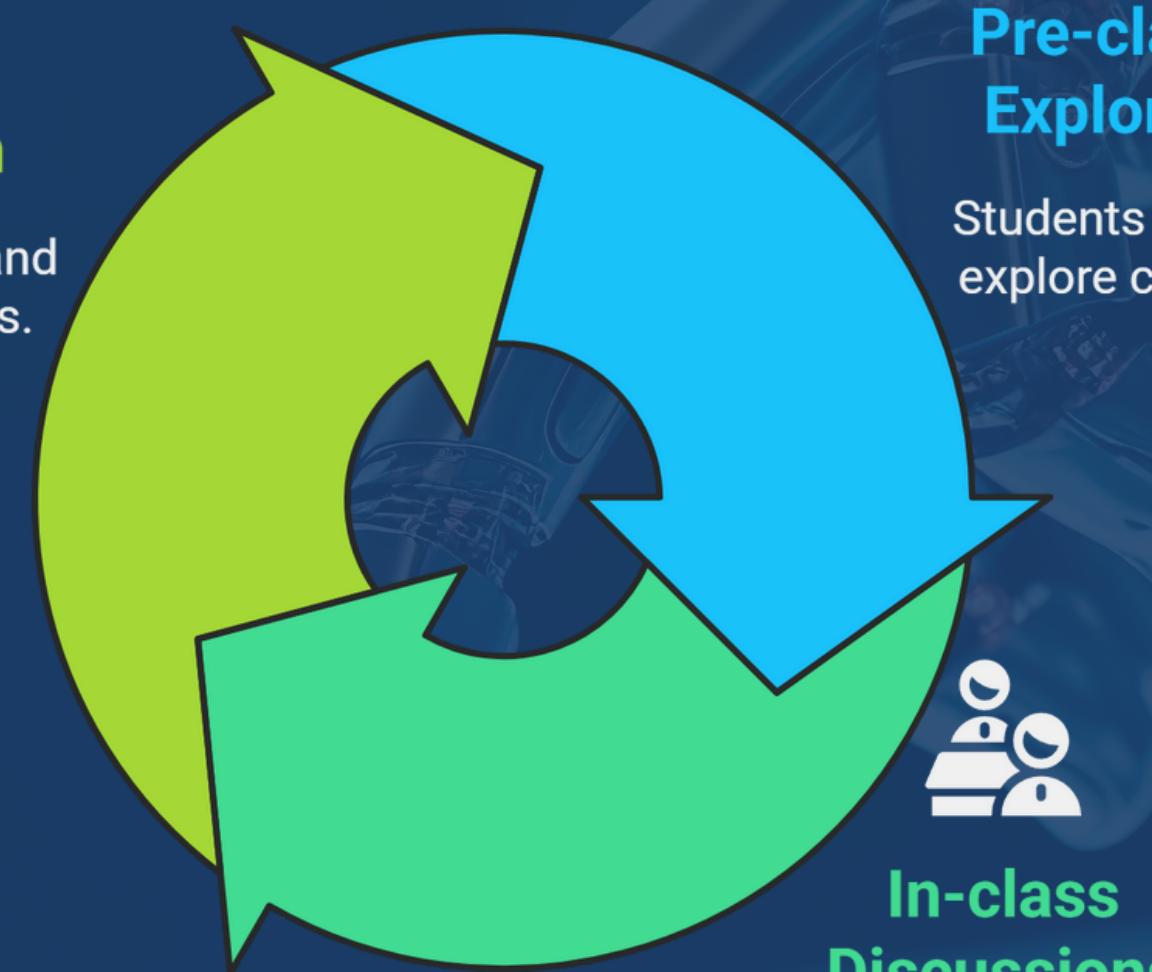


Reflecting & Replanning



Feedback Integration

Students reflect and refine AI prompts.



Pre-class AI Exploration

Students use AI to explore concepts.

Planning & Acting



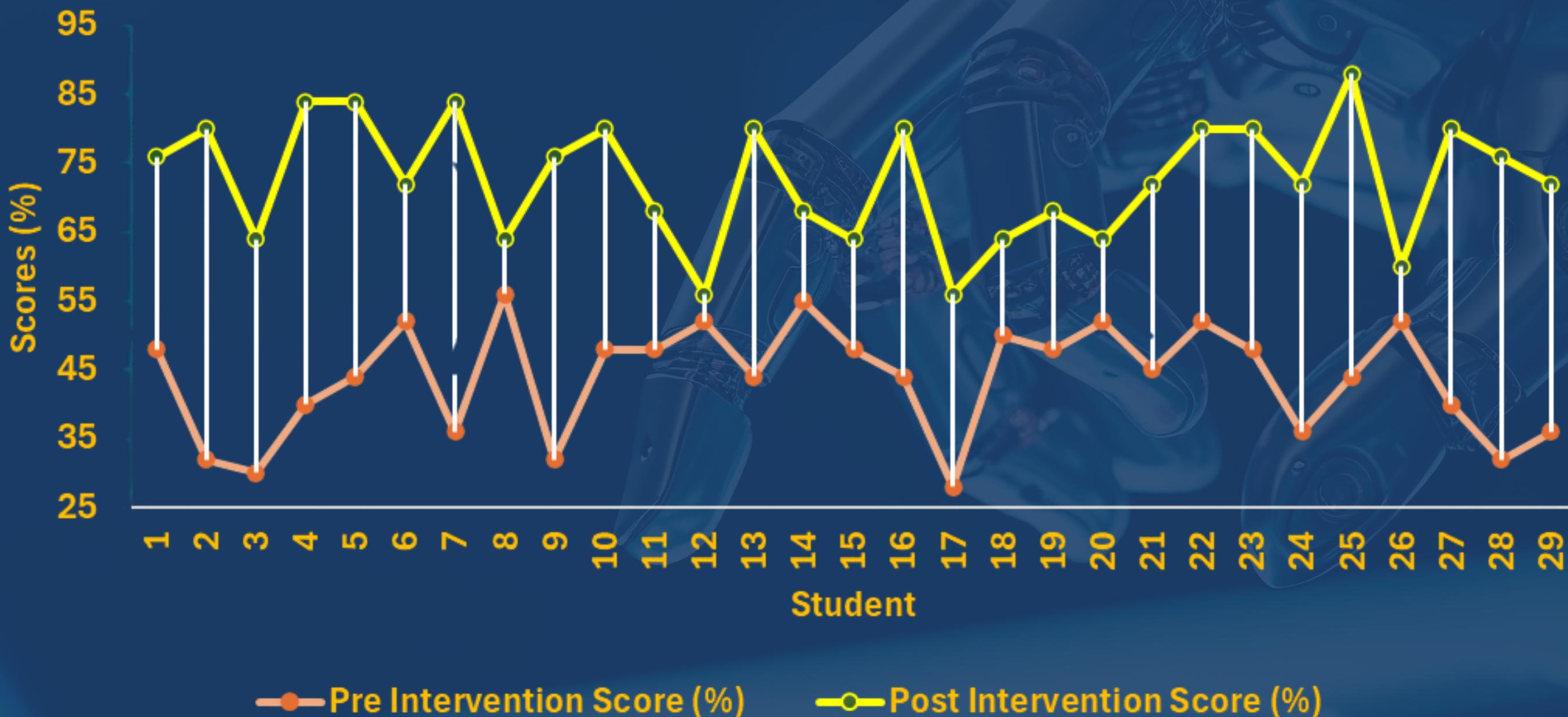
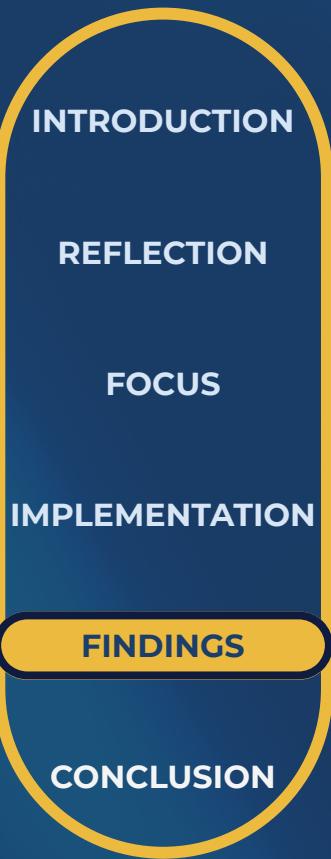
In-class Discussions

Students compare AI and textbook explanations.

Observing & Acting

ENERGY-MOMENTUM CONCEPTUAL SURVEY

Students & Their Scores



ENERGY-MOMENTUM CONCEPTUAL SURVEY



OVERALL

Pre-Intervention

46.67%



Post-Intervention
Score

70.76%

EFFECT SIZE

Cohen's d = 1.77 (Large)

Gain = 0.42 (Moderate)*

*PBL => 0.49

*<https://iopscience.iop.org/article/10.1088/1742-6596/739/1/012060/pdf>

Question Cluster Average Scores



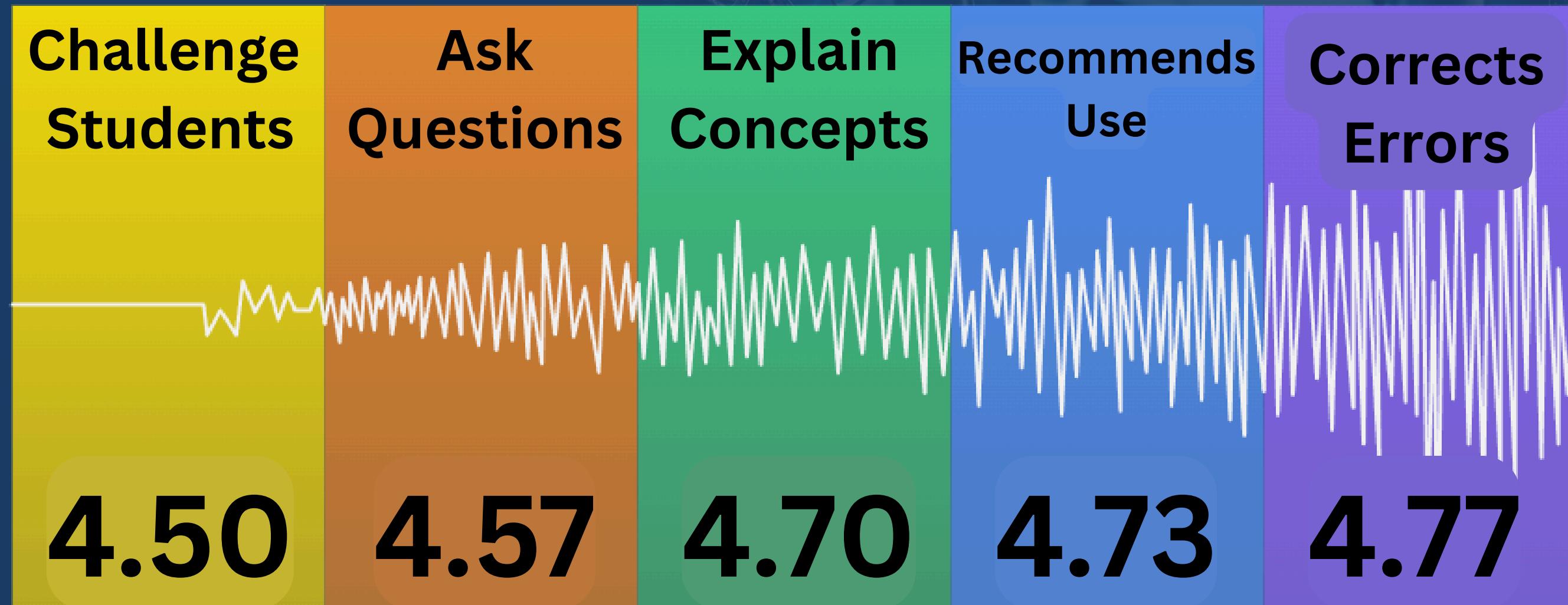


STUDENT FEEDBACK (5 POINT LIKERT)



Student perception of AI tutor effectiveness in physics learning

Less Effective ← → More Effective



REFLECTION & CONCLUSION

INTRODUCTION
REFLECTION
FOCUS
IMPLEMENTATION
FINDINGS
CONCLUSION

AI-dialogues enhances conceptual understanding in the learning of energy and momentum

Students rated the AI tutor highly (4.50–4.77/5).

Future research should:

- Use controlled studies to isolate AI's impact
- Assess long-term retention of learning
- Investigate ways to improve critical thinking support (rated 4.50)
- Explore teacher-AI integration and scalability



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QUESTIONS & ANSWERS

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