KonPPI-5 2025
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Program Matrikulasi Kementerian Pendidikan

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

Shafiq Rasulan

Kumpulan *Solus Sum* (KMSw)

Penaja
YGTHO
YAYASAN GURU TUN HUSSIEN ONN

Swiss Avenue Hotel , Sungai Petani, Kedah
10-12 Ogos 2025
Anjuran Bersama: Bahagian Matrikulasi
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- INTRODUCTION
- REFLECTION
- FOCUS
- IMPLEMENTATION
- FINDINGS
- CONCLUSION

PERSISTENT MISCONCEPTIONS

"ENERGY IS CONSUMED"
"MOMENTUM = MASS"
"MOMENTUM = FORCE"

IMPACT

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

PROPOSED SOLUTION

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

AI-POWERED TUTORING
BY SHAFIQ R

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DIAGNOSTIC DATA

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

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"

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 BEING WRONG 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.*

RESEARCH FOCUS

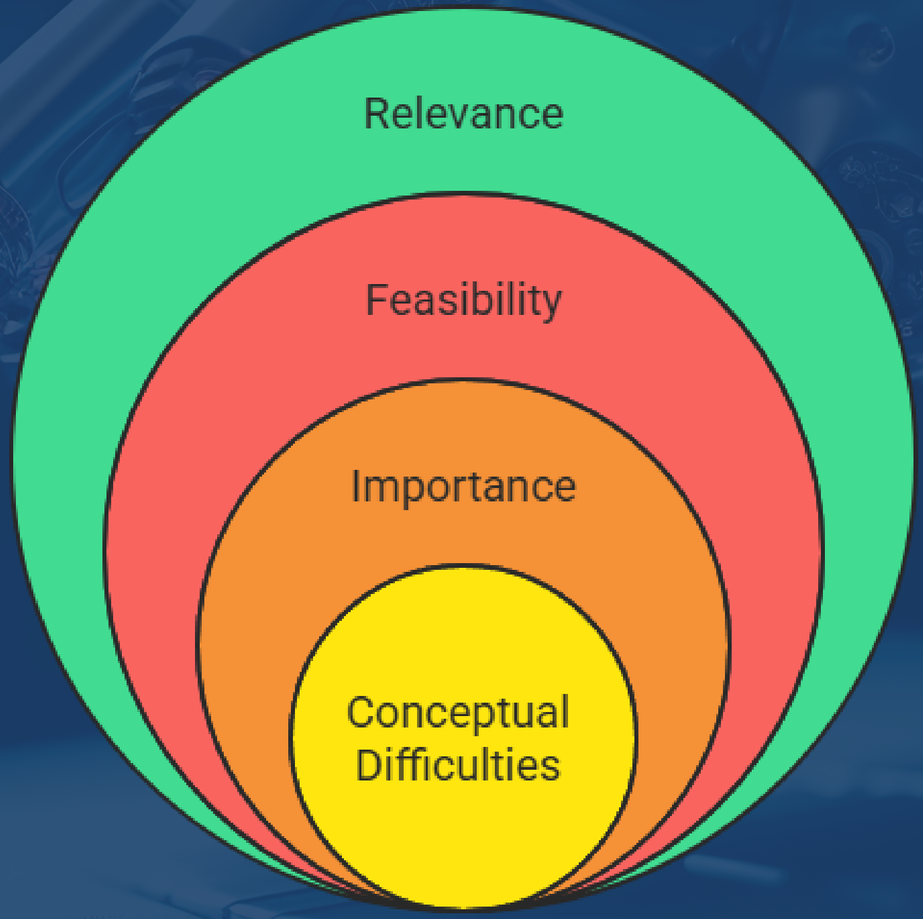
Conceptual Difficulties in Physics

Student challenges identified by assessments

Timing and AI tool integration

Foundational concepts for examination

Core challenges in energy & momentum



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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

Pedagogical Efficacy Assessment

Evaluating the effectiveness of AI tutoring systems

Learner Experience Investigation

Exploring student interactions with AI tutoring

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SOCRATIC QUESTIONING FOR SELF-INQUIRY.

PRE-INTERVENTION TRAINING

ICAP FRAMEWORK TO EVALUATE AI RESPONSES.

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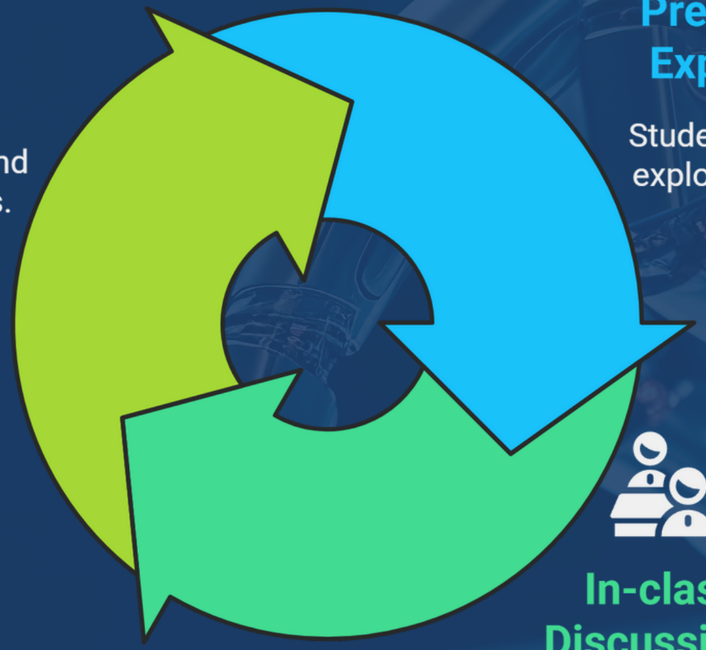
AI-Mediated Learning Cycle



Pre-class AI Exploration

Students use AI to explore concepts.

Planning: Selecting conceptual prompts and designing AI interactions is part of the deliberate preparation.

Acting: Students engage with AI tools (ChatGPT, Gemini, DeepSeek) to explore these prompts. This is the intervention in action.

In-class Discussions

Students compare AI and textbook explanations.

Observing: The teacher observes how students compare AI-derived and textbook explanations during peer discussions.

Acting (again): Facilitating debates and resolving misconceptions is a form of responsive teaching—adjusting practice based on observed outcomes.

Feedback Integration

Students reflect and refine AI prompts.

Reflecting: Collecting student reflections provides qualitative data on the intervention's effectiveness.

Replanning: Misconceptions revealed in feedback inform how future AI prompts are refined—closing the loop and beginning the next cycle.

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ENERGY-MOMENTUM CONCEPTUAL SURVEY

- INTRODUCTION
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OVERALL

Pre-Test Score **46.67%**

Post-Test Score **70.76%**

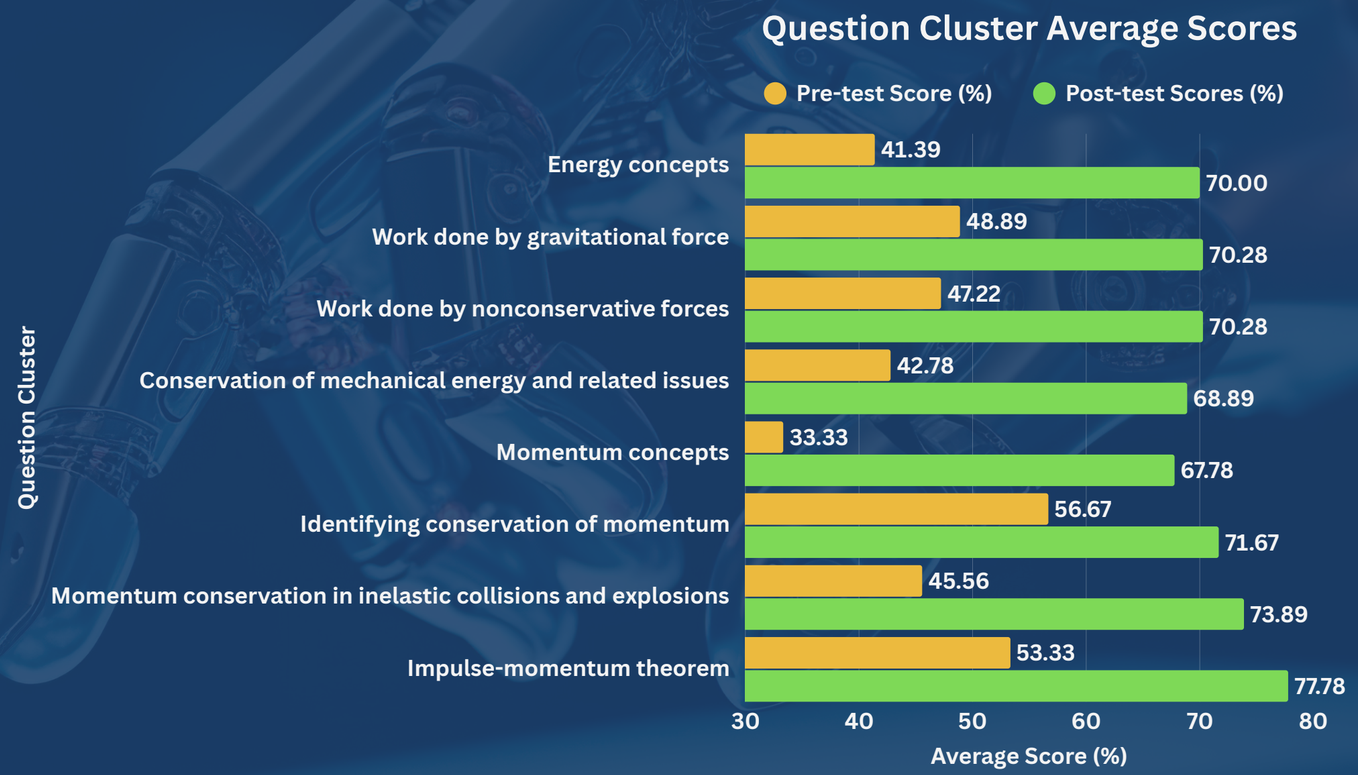
EFFECT SIZE

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



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STUDENT FEEDBACK (5 POINT LIKERT)

Student perception of AI tutor effectiveness in physics learning

Less Effective ⟷ More Effective

Challenge Students	Ask Questions	Explain Concepts	Recommends Use	Corrects Errors
4.50	4.57	4.70	4.73	4.77

REFLECTION & CONCLUSION

AI-assisted Socratic dialogue significantly 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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