AI-SUPPORTED PRE-CLASS PREPARATION TO ENHANCE INQUIRY-BASED PHYSICS LEARNING IN ENGINEERING EDUCATION

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Artificial intelligence (AI) is increasingly used to support learning, feedback, and student engagement in higher education, particularly in STEM disciplines [1]. In physics education for engineering and foundation-level students, integrating digital learning tools with inquiry-based laboratory activities can strengthen conceptual understanding and improve preparedness for active classroom learning [2].

This work explores how AI-supported preparatory activities can improve student readiness for inquiry-driven laboratory learning in foundation-level physics courses while maintaining the central role of traditional hands-on experimentation.

The teaching approach integrates several AI-assisted components to support pre-class preparation. AI-generated HTML simulations allow students to explore conceptual physics scenarios before attending the class. For example, in a circular motion topic, students interact with a virtual model of a rotating shaft lifting a weight, enabling them to observe relationships between rotational motion, force, and mechanical work prior to performing the physical experiment. Similar AI-supported simulations are also used to help students analyse complex electrical circuit problems by visualising current flow and voltage relationships. In addition, AI-generated numerical questions and guided solutions provide opportunities to practise problem-solving before class. Short “topic-at-a-glance” summaries support quick conceptual review, while AI-assisted assessment tools enable rapid formative feedback.

Preliminary observations indicate that students using AI-supported preparatory materials show improved readiness for laboratory experiments and greater participation in conceptual discussions. Student feedback also highlights that regular homework resources and weekly practical sessions support understanding and engagement. AI-supported learning environments can further enhance student engagement and problem-solving skills in STEM education [3].

The approach demonstrates how AI tools can complement rather than replace traditional inquiry-based teaching practices. By supporting preparation before class, AI allows classroom time to focus on guided questioning, conceptual dialogue, and experimental investigation. The proposed model therefore offers a transferable framework for integrating AI-supported preparation within physics teaching for engineering and foundation-level STEM education [4].

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