



AI-Driven Inquiry Framework for Strengthening Undergraduate Research Engagement in Engineering Classrooms

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This study introduces an AI-driven inquiry framework designed to expand undergraduate participation in research through structured course-based undergraduate research experiences (CUREs). Engineering classrooms often struggle to provide research exposure to large cohorts due to limited faculty time, uneven student preparedness, and the absence of systematic inquiry processes. Integrating artificial intelligence into the instructional design offers a scalable solution. The proposed framework employs AI tools for literature exploration, problem framing, data augmentation, rapid prototyping, and basic model evaluation. Students participated in guided research cycles where AI systems supported idea generation, hypothesis refinement, and interpretation of outcomes, while retaining students' responsibility for methodological choices and analytical reasoning. The model was implemented across multiple undergraduate sections with emphasis on collaborative research problems such as environmental analytics, cybersecurity pattern detection, and socio-technical data interpretation. Evaluation of student outcomes demonstrated notable improvements in research readiness, conceptual clarity, and ability to communicate findings. Students reported that AI scaffolding reduced cognitive barriers to initiating research, enabling them to focus on experimentation, reflection, and critical synthesis. Faculty members also observed increased participation from students who traditionally remained disengaged from research activities. The findings affirm that AI-enabled inquiry frameworks can significantly broaden access to meaningful research experiences within regular coursework. By lowering the entry threshold and supporting structured collaboration, this approach strengthens institutional research culture and prepares students for deeper academic, industry, and innovation-driven roles.

Keywords: AI-Driven Inquiry, CURE Pedagogy, Undergraduate Research Engagement, Engineering Education, Collaborative Learning.
