International Conference on
TEACHING, LEARNING and EDUCATION

28 - 30 November 2025 Vienna , Austria

Embedding Ai-supported Critical Thinking and Ethical Reasoning in Environmental Engineering Education

Katelyn Johnson

Stellenbosch University, South Africa

Abstract

As the use of artificial intelligence tools become increasingly prevalent, engineering education must evolve to prepare students for AI-augmented decision-making while developing robust critical thinking and ethical reasoning capabilities. This study investigates the impact of AI integration on students' critical thinking abilities and ethical reasoning in environmental engineering contexts through a mixed-methods approach, involving 73 undergraduate students. The intervention included three key activities: AI-assisted ethical scenario analysis using real-world environmental engineering dilemmas, comparative concept learning where students defined key environmental legislation independently before comparing with AI-generated definitions, and AI-augmented assignment critique where students evaluated their Environmental Impact Assessment work using AI tools before critically analysing the feedback quality. Data collection employed pre/post surveys, reflective journals, and assignment assessments to measure changes in critical thinking abilities, ethical reasoning competency, and AI evaluation skills. Preliminary findings demonstrate significant improvements in students' ability to identify limitations in AI-generated ethical analyses and increased confidence in challenging AI recommendations when they conflicted with professional ethical standards. Students showed enhanced metacognitive awareness, with several students reporting improved ability to articulate reasoning behind their ethical judgments. Rather than becoming dependent on AI tools, students developed individualised frameworks for evaluating AI reliability in professional contexts. This research provides evidence-based strategies for embedding AI tools in environmental engineering education while strengthening critical thinking and ethical reasoning capabilities, offering a replicable pedagogical framework for engineering educators.

Keywords: Competency Development, Higher Education, Metacognition, Technology Integration, Self-Directed Learning