

Scaling Undergraduate Research Training: Course Design and AI Innovations in the MCDB SkillsCenter



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The following is an excerpt from a longer piece. For the full text, please scan the QR code.

Abstract

Undergraduate research experiences are among the most powerful predictors of persistence and identity formation in STEM education. Yet, ironically, access remains limited by faculty time, laboratory resources, and scalability. The MCDB SkillsCenter is a novel course at the University of Colorado, Boulder, targeted at these challenges by combining modular skill-based learning, peer mentorship, and digital infrastructure to make authentic research training accessible to large student populations. Documenting the SkillsCenter's evolution from a small program into a scalable course, this thesis evaluates its pedagogical foundations, digital footprint, and next phase of innovation through artificial intelligence (AI).

At its core, the SkillsCenter is grounded in mastery-based pedagogy, emphasizing iteration, feedback, and agency as drivers of persistence and confidence in scientific training. Between 2021 and 2025, the results depict that enrollment expanded nearly nine times while maintaining individualized mentorship through a peer-proctor system. Meanwhile, the adoption of Microsoft Power Platform cloud infrastructure paved the way for automation of student submission, proctor grading, and micro-credentialing, helping increase certification output from 76 to 575 per semester. Essential feedback cycles between pedagogy and technology also promoted transparency, standardization, and efficiency. Looking at its next innovation, an AI study demonstrated that GPT-5 nano and GPT-5 mini models achieved up to 80% agreement with human evaluators, performing the strongest on objective rubric items. While interpretive assessment remains a limitation, the evidence suggests AI's capability to increase efficiency as a supplemental tool.

Taken together, the SkillsCenter illustrates that authentic undergraduate research training can scale, especially when pedagogy and technology evolve together, creating a transferable framework for expanding equitable research education across STEM.