SCALED: A Transferable Learning-Engineering Model for Large-enrollment STEM Courses

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high-enrollment multi-modality Scalable course design

Extended Abstract

Introduction

High-enrollment gateway courses in engineering face pressures to expand access while improving quality and consistency across sections and modalities (Meuth et al., 2025). This poster presents Scalable Convergence Across Learning Experiences and Disciplines (SCALED) model that leverages learning engineering principles to address these pressures.

Our Approach: Learning-Engineering Intervention

We redesigned the first-year programming course as a unified “mega-course” that delivers a comparable learning experience across on-campus, online, and MOOC modalities. Using a flipped design, students progress through short videos, readings, low-stakes coding activities, tutorial-style labs, and weekly summative programming projects. Four proctored exams are mapped to micro-learning objectives to support comparability. Course materials are primarily delivered by zyBooks, a web-based interactive textbook platform, whose auto-grading and immediate feedback free the instructional team for coaching. Learning community support is integrated via Inscribe. Analytics flag students who spend more than 60 minutes on an assignment without improving, triggering outreach with hints and resources. Bi-weekly progress messages direct students to office hours and forums. These mechanisms sit within a nested Learning Engineering cycle (Craig et al., 2025) that analyzes assessment performance, time-on-task, DFW patterns, and end-of-course feedback for course revisions.

Findings: The SCALED Model

Over seven years, outcomes align with the model's aims. DFW rates have decreased, and retention increased relative to the lecture-centric format. End-of-course evaluations are reliably higher ($p < .014$ across seven large sections; $d > 1.75$). Enrolling 3,000+ students per semester across modalities, the mega-course has crystallized into SCALED, a technology-enhanced instructional model consonant with NCAT's principles (NCAT, n.d.) and characterized by a digital foundation (interactive content, auto-grading, analytics), collaborative design and delivery (coordinated teams of faculty, graduate and undergraduate TAs, graders), student-centered pedagogy (frequent feedback, active learning, learning communities), academic-unit coordination (program, advising, student support) and iterative outcomes-driven design.

References

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