BOARD # 277: NSF IUSE: Embedding Critical Consciousness in the Engineering Design Curriculum during the Middle Years

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Renata A. Revelo is a Clinical Associate Professor at the University of Illinois, Chicago in the department of Electrical and Computer Engineering. Her research focuses on shifting the culture of engineering via the study of engineering identity and the study of curricular change.

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Dr. Joel Alejandro (Alex) Mejia is a Professor of Engineering Education in the Department of Engineering and Computing Education at the University of Cincinnati. His work examines the intersections of engineering, social justice, and critical pedagogies. He focuses on dismantling deficit ideologies in STEM, centering Latino/a/x student experiences—especially of those along the U.S.-Mexico border. His work draws on Chicana/o/x studies, raciolinguistics, and bilingual education to explore how language, race, and socialization shape engineering pathways and engineering practice. In 2025, Dr. Mejia received the Presidential Early Career Award for Scientists and Engineers (PECASE) Award for his contributions to engineering education.

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Luis Montero-Moguel is a Ph.D. Candidate in Interdisciplinary Learning and Teaching specializing in STEM and Engineering Education education at The University of Texas at San Antonio (UTSA). Luis holds an MSc. in Mathematics Education from the University of Guadalajara and a BS in Mechanical Engineering. Luis is an NSF-CADRE fellow. As part of his doctoral program, Luis has earned a Graduate Certificate in iSTEM Education and a Graduate Certificate in Engineering Education. With experience as an engineer and a mathematics teacher, he promotes the expansion of equitable and high-quality learning opportunities for both engineering and K–12 students through mathematical modeling. His research focuses on exploring the process of refining mathematical ideas and engineering concepts that engineering students develop while engaging in model development sequences built in real engineering contexts.

NSF IUSE: Embedding Critical Consciousness in the Engineering Design Curriculum during the Middle Years

This NSF IUSE research collaboration between the University of Illinois Chicago (Grant #2215408) and the University of Texas at San Antonio (Grant #2215788) focuses on curriculum design for early and mid-level engineering courses (e.g., first-year, sophomore, junior level) that emphasize engineering design. The partnership led to the creation of a course that integrates critical consciousness and Freire's [1] dialogic principles into the teaching of the engineering design process. This approach addresses two significant gaps in engineering education: (1) the shortage of mid-level design courses, and (2) the need for a contextualized engineering curriculum.

Since spring 2023, both institutions have offered this course at least twice, attracting students from their respective engineering colleges. The course has been offered and open to all students that meet the course pre-requisites, which is a standard practice in engineering. While the institutions serve slightly different student populations and implement the course with some variations, the outcomes have been consistent. These include increased student understanding of the social, cultural, economic, and political aspects of design, a stronger sense of engineering identity through project development, a focus on community-centered design, and improved peer-community building through the dialogic practices used in the course.

The framework for this course integrates the engineering design process taught along critical consciousness topics. These topics contextualize engineering design by incorporating social, cultural, economic, and global aspects of design. These topics are discussed through the use of exemplary engineering innovations. Layered on top of these components, we also include elements of Intergroup Dialogue (IGD) [2] practice. IGD is incorporated to center dialogue in this engineering course and allow students' reflection on the role of engineers in design through a discussion of critical consciousness. All of these components make up a teaching framework that has been presented at the 2024 Frontiers in Education conference through a special session and at the 2025 ASEE Illinois-Indiana section conference. Doing so, has allowed a broad dissemination of the teaching framework to the engineering education community.

The knowledge generation portion of this project includes a multiple method assessment using semi-structured interviews, online surveys, and document analysis. While all of these data are utilized in the assessment, the interview data was prioritized. The interview protocol and survey focus on two strands of assessment: gains in critical consciousness, and engineering identity development. The document analysis is used to triangulate findings from the interview data analysis, and it includes review of student project reports and weekly reflections from the course. So far, we have conducted interviews with two cohorts of students at each institution. While overarching data analysis across all cohorts and both sites is undergoing, we have previously published the results of these interview data analysis [3], survey analysis [4].

This poster offers valuable insights for educators interested in incorporating dialogic methods into their engineering curriculum and for those who aim to enhance design knowledge by integrating contextualized perspectives.

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References

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