

# Special Session: Implementing a Teaching Framework of Critical Consciousness Embedded in Engineering Design Courses

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**Abstract**—This special session will provide an opportunity for educators to learn about critical consciousness and how to embed topics intended to promote the development of critical consciousness in the engineering design curriculum. The authors will present a critical consciousness teaching framework, which incorporates the engineering design process with critical consciousness topics through intergroup dialogue and discussion of engineering innovations. Session participants will engage in interactive activities to understand the framework, ideate how it may be adapted at their own institutions, and review case studies of challenges and affordances of using the teaching framework.

**Keywords**—critical consciousness, Freire, engineering design, intergroup dialogue

## I. GOALS

This session aims to provide attendees with a teaching framework that incorporates contextual perspectives into design courses. The authors developed the Critical Consciousness Teaching Framework (CCTF) to enrich teaching the engineering design process. The framework incites educators to teach the design process from a contextualized perspective that purposefully goes beyond user-centered, human-centered, and universal design. This approach is grounded on Freire's critical consciousness construct [2], which is a process of understanding a person's position in the world that surrounds them through reflection and action. Through critical consciousness, a person becomes knowledgeable about systems of oppression and has a willingness to act in response to this knowledge. The critical consciousness process happens in company with others using dialogical practices; thus, it promotes a more critical understanding of the world and the complex systems that create social inequities.

## II. DESCRIPTION AND SELECTED RELEVANT LITERATURE

In this highly interactive special session, the presenters will engage the audience in learning about and testing out various aspects of a CCTF. The teaching framework is currently being used at two different institutions to teach critical consciousness topics alongside the engineering design process. The CCTF has the following components: (1) intergroup dialogue, (2) community-focused projects, (3)

critical consciousness topics, and (4) engineering design process.

### A. Intergroup Dialogue

Intergroup dialogue (IGD) is a communication practice that was developed at the University of Michigan to enable social groups to dialogue with one another about societal differences across groups (e.g., gender, sexuality, religion) [3]. IGD was adapted to the CCTF teaching framework rather than being implemented in its standard form [4]. Instead, some aspects of dialogue-focused pedagogy (such as those in IGD) are implemented in an effort to facilitate understanding, empathy and collaboration among diverse groups. These include: (1) community guidelines for dialogue, (2) positioning dialogue pedagogy ahead of other forms of communication (e.g., debate, discussion), and (3) learning activities to promote group growth in dialogue and to progress group through dialogue stages.

The incorporation of IGD into the Critical Consciousness Teaching Framework is also aligned with Freire's critical pedagogy which centers on dialogue [5]. Dialogue is a necessary component of Freire's conceptualization of critical consciousness. Without dialogue, a person would not be able to fully understand their circumstances and the world that surrounds them [2]. Freire speaks of dialogue as a humanizing praxis, where being in conversation with others helps one to understand better the world that surrounds them.

### B. Community-Focused Projects

Teaching the design process from a critical consciousness standpoint aims to show students that innovation and design do not happen in a vacuum. To demonstrate this, community-focused projects and community-oriented projects are integrated into the curriculum to allow students to work through this idea through a practical, first-hand experience. These projects are implemented in two slightly different ways at each institution. At one institution, students propose a project about an innovation in their city that would transform the city. At the other institution, a community-based organization proposes a project enabling them to improve their work in the community. In both scenarios, students must think through ways to work alongside community to develop a preliminary design that

empowers the community. These projects are purposefully chosen to exemplify critical consciousness topics and ideas taught in the course. Case studies created for this special session will explore how community-focused projects can be integrated into design courses.

### *C. Critical Consciousness Topics*

The conceptualization of Freire's critical consciousness is broad and not prescriptive; however, there are two components of critical consciousness that are central to the concept and are present in many adaptations of critical consciousness. These components are reflection and action, which were considered centrally when determining the critical consciousness topics for the course. Reflection involves critically examining one's own experiences, beliefs, and societal structures, which includes deep introspection, questioning assumptions, and understanding how personal experiences are shaped by larger societal forces. This process also involves analyzing power dynamics within social, economic, and political systems, recognizing the roles institutions play in perpetuating inequality, and understanding historical contexts and the legacies of colonialism, racism, and other forms of oppression. Action, on the other hand, is the practical application of the insights gained through reflection. It includes advocating for policy changes, engaging in activism, building alliances, and supporting grassroots initiatives aimed at empowering marginalized communities. Action also involves raising awareness about social injustices, creating inclusive and equitable spaces, and committing to ethical behavior in personal and professional conduct. These topics will be reviewed during the special session.

### *D. Engineering Design Process*

The engineering design process is incorporated in a linear manner throughout the semester. The engineering design process provides the structure for the course, wherein the rest of the course components are integrated around it. This is achieved through a discussion of engineering innovations. Because the teaching of engineering design in higher education is widespread, in this special session, we will discuss how the engineering design process is used to provide structure to incorporate the rest of the teaching framework components.

## III. RATIONALE AND NOVELTY

While critical consciousness has been widely implemented in programming and pedagogy in other fields of higher education, it has not been widely implemented in engineering education. Incorporating critical consciousness into engineering education, specifically in engineering design, allows for a discussion of social impact beyond human-centered, user-centered, or universal design. It can incite students to think deeply and systemically about their role and responsibility as engineers.

## IV. AGENDA

The agenda components also reflect pedagogical practices that are used in the teaching framework presented so that participants can see them in action.

### *A. Audience & presenter introductions, 10 mins*

During this time, presenters and session attendees will introduce themselves.

### *B. Community guidelines/aspirations, 5 mins*

Attendees and presenters will establish community guidelines and aspirations as a large group. The IGD community guideline handout will be used as a starting point.

### *C. Ice breaker, 10 mins*

Attendees will participate in 1-2 exercises in smaller groups to learn more about each other and establish some rapport.

### *D. Content presentation of teaching framework & components, 15 mins*

1. Contextualize UTSA and UIC course differences
2. Course timeline
3. Integration of intergroup dialogue

### *E. (Content "break"): Quick audience engagement: four corners, 5 mins*

Four corners exercise to situate participants' thinking in response to the following prompt: Topics such as capitalism, color evasiveness, militarism can be and should be incorporated into a design course.

4. CC topics alongside design topics
5. Class flow
6. Course assessments

### *F. Case study review: 15 mins*

- Case study of a situation in classroom for participants to discuss how to improve the lesson plan using the teaching framework (improvement focused)
- Case study for participants to go through the exercise of putting aspects of a lesson plan together using the teaching framework (development focused)
- Open case study for participants who want to use the teaching framework to tailor a lesson plan for their course (development or improvement focused)

### *G. Audience engagement: fishbowl, 15 mins*

- Fishbowl exercise for participants to discuss/debrief the case studies

### *H. Close out & resources, 10 mins*

- Sharing syllabi
- Sharing research results (publications)

## V. EXPECTED OUTCOMES

Below are the expected outcomes for this special session:

- Session participants will review pedagogical tools that could be transferred to their own courses
- Session participants will discuss the teaching framework used to incorporate critical consciousness topics into design (and other) courses.

- Session participants will interact with others to discuss ideas for implementation of the teaching framework at their own institutions.

## VI. ABOUT THE FACILITATORS

Renata A. Revelo is a Clinical Associate Professor in the Department of Electrical and Computer Engineering at the University of Illinois Chicago (UIC). She is the PI of an NSF grant (IUSE #2215408) titled “Teaching Engineering Design with a Contextual Perspective,” which aims to investigate the impact of embedding critical consciousness topics alongside the design process in a sophomore-junior level course. Dr. Revelo has 7+ years of experience teaching design courses at UIC, and she has multiple publications, including book chapters, in the field of engineering education. She is a proud first-generation college student and immigrant to the United States. Dr. Revelo earned her Masters in Electrical and Computer Engineering and her Ph.D. in Education Organization and Leadership from the University of Illinois at Urbana-Champaign.

Dr. Joel Alejandro (Alex) Mejia is an Associate Professor with joint appointment in the Department of Biomedical Engineering and Chemical Engineering and the Department of Bicultural-Bilingual Studies at The University of Texas at San Antonio. He is the PI of the NSF grant (IUSE # 2215788) titled “Teaching Engineering Design with a Contextual Perspective,” at The University of Texas at San Antonio. Dr. Mejia has 9+ years of experience teaching engineering courses on user-entered design and social justice in engineering contexts. His research focuses on analyzing and describing the assets, tensions, contradictions, and cultural collisions many Latino/a/x students experience in engineering through testimonios. He received a CAREER award in 2020 to explore the career pathways of Latino/a/x engineering students. Dr. Mejia received his BS and MS in Metallurgical and Materials Engineering and his PhD in Engineering Education.

Julio C. Mendez Sr. is a PhD student at the University of Illinois at Chicago. His research interests are the intersection of teacher preparation and engineering education as it pertains to the education of urban youth. He currently teaches high school physics and pre-engineering in Chicago. Julio attended a private engineering university out of high school and lived the disconnection between engineering education and his life experiences as an immigrant and ethnic minority in the United States. He did not matriculate through his first attempt. After a sixteen-year detour through trade work in auto repair, Julio made the transition back to academia for a bachelor’s degree in physics and then a master’s degree in science education, which helped fuel a passion to teach and especially to teach in the same urban environment in which he grew up. Years of success teaching youth from his city pushed him to realize a strong desire to learn more about teaching as a profession and the ways in which he could help improve the education systems.

## VII. ACKNOWLEDGMENTS

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