Critical Educational Theory: Applications in Engineering Education

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Critical theory is used to understand economic inequities in engineering education and inform the application of pedagogies to address the root causes of academic issues faced by working class students in engineering.

What is the Root Cause of Inequities in Education?

"There is, and there always has been, a dialectical relationship among **education, politics, and power.**"

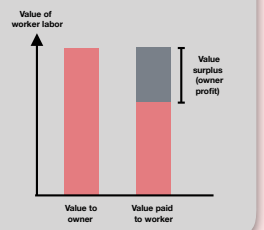
- Ana Maria Araújo Freire [1]

Increasing global income inequality is caused by poor distribution of **capital** throughout our societies [2]. Economic production results in capital, and people with similar relationships to the means of production are said to be of the same **social class**.

- **Workers** directly sell their labor in exchange for consumption capital, which is used to sustain their livelihoods
- **Owners** receive the profits of production, which are used as investment capital to produce further capital

Through this process, as well as racist and sexist economic and social practices, unfettered capitalism results in the labor of millions of workers being exploited to generate profits for those of the higher social class.

The Capitalist Law of Value [2]



Critical Theory of Education [2, 3]

Common beliefs about education in capitalism:

Education brings people out of poverty **and** Education supports the capitalist economy ≠ Increased inequality means more people are in poverty

therefore ↑

but → Stronger capitalist economy means increased inequality

In capitalist countries, the paradox of education becomes apparent as education is viewed as the vessel that brings people out of poverty, but, at the same time, education is viewed as fuel for the capitalist economy [2,3]. Both can't be true, because capitalism itself is locking people in structural oppression. Thus, education actually reproduces the inequalities it is said to be fighting.

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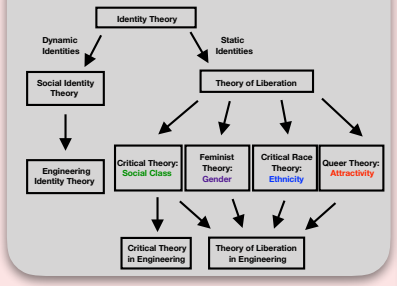
How Do We Understand Inequities in Engineering?

Model of Relations Between Identity-Based Theories



Relations Between Liberative Theories

- **Social identity theory** focuses on internal cognitive processes that form beliefs of others' identities as well as shape behavior in order to achieve specific identity labels [4]. **Engineering identity theories** have tailored this theory to the development of identities that represent a feeling of belonging within engineering communities [5-7].
- **The theory of liberation** emphasizes the role of structural factors in presenting or withholding opportunities based on *all* socially-constructed identity labels [8]. The ultimate aim is to dismantle the systems that lock people into oppressive realities. **Liberative theorists in engineering** recognize and work to counter structural oppression within engineering education and in access to and use of engineering technologies.
- **Critical theory** identifies exploitive capitalist structures as the cause of oppression against the working class [2]. **Feminist, critical race, and queer theories** highlight oppression against marginalized groups based on gender, ethnicity, and attractivity, respectively [9-11].
- The **theory of intersectionality** poses that specific attributes of various aspects of identity must be considered concurrently [12].

How Do We Address Inequities in Engineering?

Teaching

The solution to cyclic oppression lies in transforming social and economic structures, and that requires awareness and understanding of the experiences of those of social groups who are marginalized within our current structures. As engineering educators, we can aid in these transformations through the use of liberative and critical pedagogies.

ANTI-OPPRESSIVE PRINCIPLE	ENGINEERING EDUCATION EXAMPLE
Use problem topics that are relatable and non-threatening [2,8]	Use problems involving food refrigeration rather than car motors [8]
Build a cooperative learning environment [8]	Do not compare students when assigning grades
Give students authority over learning [8]	Give students teaching roles by having them explain problems [8]
Include ethics, policy, and social justice [2,8]	Give assignments and hold in-class discussions on ethical issues [8]
Acknowledge privilege and power [2,8]	Discuss who has access to engineering technologies [8]
De-center western civilization [8]	Include non-western scientists in notable figures [8]
Allow marginalized students to share their realities [2,13]	Acknowledge and discuss discriminatory incidents in the community
Identify sources of oppression and exploitation [2,14]	Discuss destructive and oppressive uses of engineering technologies
Help students identify their role as workers [2,15]	Acknowledge graduate student labor as a system of oppression

The goal is *not* to aid marginalized students in assimilating into the dominant culture [8].

The goal is to change the culture itself through the creation of spaces that amplify marginalized voices and support the organization of liberative efforts.

Future Research

In applying identity-based theories to engineering education, work has been done to tailor social identity theory specifically to engineering students [5-7], but this work is not anti-oppressive. Using liberative frameworks, liberative pedagogy has been applied to engineering classrooms [8], intersectionality has been applied in a qualitative study of female engineering students [16], and feminist, critical race, and queer theory have been applied to investigate student experiences [9-11]. We are now pursuing a mixed-methods study that applies critical theory to academic issues faced by engineering students from low-income backgrounds. Specifically, we want to know:

- Is family income level correlated to graduation rate, time to graduation, and/or academic performance of engineering undergraduate students?
- In what ways does being of low socio-economic status affect engineering undergraduate students throughout their college careers?

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