Changing Paradigms for Diversity in Undergraduate Engineering Education through Critical Cultural Research

Stephen Secules

Florida International University
Biography

Academic studies in engineering and acoustics.

5-years industry experience as acoustical consultant, working in Silicon Valley and London.

Returned for PhD in Education focused on equity and culture in undergraduate engineering education.

Approach research on everyday engineering educational settings from a qualitative and anthropological lens, hoping to provide new insight.
Agenda

Diversity in Engineering Paradigm

Critical Cultural Research

Examples of Work
- Classroom Critical Ethnography
- Agency through Narrative

Co-Constructing the New Paradigm
What are causes of disparities in engineering you’ve heard named? (gender, racial, socioeconomic, etc.)
What are causes of disparities in engineering you’ve heard named?

(gender, racial, socioeconomic, etc.)
Typical Paradigm for Talking about Diversity in Engineering

Focus on the **individual student**

- Spotlight a student’s individual qualities (motivation, demographic identities, upbringing)
- Explain student success and failure in terms of those qualities

Root the problem in parts of the system **beyond our control**

- College teachers blame their students’ high school preparation
- High school teachers blame parents
- Industry blames the lack of qualified applicants

Take action in a way that is **easy and convenient**

- Celebrate students overcoming the odds instead of tackling the marginalization and inequities
Critical Cultural Paradigm

Focus away from the individual to the system and the culture

- Individuals are not simple examples of their traits, demographic groups, or backgrounds.
- Uncover the larger roots of inequities + culture (norms, habits, what is taken for granted) that impact those individuals.

Focus on changing the parts of the system within our control

- Social problems are deep-rooted, not individually caused by anyone.
- We are not individually to blame for them, but we are each responsible to help shift them.
- Each of us can best understand and tackle problems in our own “backyard”.

Focus on the change efforts that matter the most

- Having brave and honest conversations and taking important action.
What are the Causes of Disparities in Engineering?

Examples:

- Student aptitude and interest
- Parental involvement
- Children’s toys
- High school preparation
- Segregated school systems
- Lack of prior knowledge about engineering
- Lack of inclusion in classrooms
- Financial and course credit systems that privilege higher socioeconomic backgrounds
Critical Cultural Research

- Using observations to look critically at engineering culture and systems
- Looking beyond an individual’s traits or upbringing to what circumstances are created for the individual
- Using interviews to understand a culture from the student’s perspective, instructor perspective
- Taking an active role—challenging stereotypes in interview, reorganizing classrooms practices, collaborating to ask and answer tricky questions
Questions?
Critical Cultural Research Projects
Critical cultural study in an introductory programming course for undergraduate electrical engineers.

Context: Becca, one of three women in an introductory programming class of 29, is struggling. She went to a high school without computer programming courses and isn’t yet admitted to the engineering major. She’s worried maybe she’s just not cut out for engineering.

Where does Becca’s problem come from?

I could never like fully be like feeling accomplished or like I wanted to stay in this class I, really, like this entire semester I’ve been like I hate electrical engineering, I’m not doing this. I’m not even in it and I wanna quit.

Becca

How we think about Becca’s problem impacts how we respond.
Context: Becca is **one of three women** in an introductory programming class of 29, is struggling. She went to a **high school without computer programming courses** and **isn’t yet admitted to the engineering major**. She’s worried maybe she’s just not cut out for engineering.

Where does Becca’s problem come from?

If we think of Becca’s being “not cut out for” engineering as caused by demographics and prior socialization, we have very few options to help.
If we think about the problem with a critical cultural lens, we notice the pattern is bigger than just Becca.

The problem of a student being “not cut out for” engineering is created by a culture in which students being “not cut out for” engineering is normal and inevitable.
How did educational culture create...

- Spotlighted social labels
- Status in seating choices
- PowerPoint slide jargon
- Lecture discourse patterns
- Individual lab work norms
- Group lab work norms

...the problem of “not cut out for” engineering?
How did educational culture create the problem of “not cut out for” engineering?

Social labels impact the classroom.

Gender
Academic Status
Prior schooling
Prior content background

Race
Ethnicity
Disability
Language learning status
Sexual orientation
Gender normativity

We share cultural meanings for these categories in engineering. Awareness of a stereotype can impact student performance. Social labels can “spotlight” the performance of minority students for instructors.
How did educational **culture** create the problem of "**not cut out for**" engineering?

Spotlighted social labels

Students perceived **status** in lecture seating choices.
How did educational culture create the problem of “not cut out for” engineering?

Spotlighted social labels
Status in seating choices

PowerPoint slides used high level vocabulary.

Lecture Classroom Culture

Typical PowerPoint slide from Day 2:

Slide 29
#define CHARGE -1.602e-19 /* new feature */
#define EPSILON_0 8.854e-12
#define PI 3.141592654

Pre-processor directive “define” generates symbolic constants. Constants are replaced in code by numeric values before compilation.

Imagine reading this as a programming student.

How do you react?
How did educational culture create the problem of “not cut out for” engineering?

Lecture Classroom Culture

Spotlighted social labels

Status in seating choices

PowerPoint slide jargon

Programming-experienced students dominated classroom discourse.

Discourse Pattern:

Student question on tangential high level topic.

Professor:
“That’s way beyond the scope of the class, but…”
How did educational culture create the problem of “not cut out for” engineering?

Spotlighted social labels

Status in seating choices

PowerPoint slide jargon

Lecture discourse patterns

Individual labwork became a public display of who finished first.
How did educational culture create the problem of "not cut out for" engineering?

Laboratory Classroom Culture

- Spotlighted social labels
- Status in seating choices
- PowerPoint slide jargon
- Lecture discourse patterns
- Individual lab work norms
- Group lab norms created a double bind for programming-inexperienced students:

  "Me and Diana [student with low programming experience] don't know anything, and I know we're gonna die in lab."

  "My other partner Sam [student with high programming experience], he's awesome. He teaches me while he does it."
How did educational culture create the problem of “not cut out for” engineering?

- Spotlighted social labels
- Status in seating choices
- PowerPoint slide jargon
- Lecture discourse patterns
- Individual lab work norms
- Group lab work norms

Becca received an A- in the class, but left electrical engineering the next semester. She considered switching to mechanical engineering but hearing that it still involved programming, decided she shouldn’t.

The emotional strain of being found “not cut out for” engineering in this class culture turned that experience into a destiny.
Questions?
Agency through Narrative

Engaging in critical dialogue with students to help process experiences of marginalization together.

Provides a form of agency to tell one's own story.

And this sounds awful because now I’m gonna like- and in our seminar they’d be like ‘Oh girls don’t let them be like let you do like all the organizational stuff’ and to me that’s ridiculous because how-- is it a bad thing that I know, cause there’s two other girls in my group. And I will admit, the guys are more like techy and they’re more like into it and we’re more like the overviewers. And to me it’s completely unfair that the girls are also expected to be a guy in engineering and I think that’s one of the things that also gives me comfort that I am a girl and I am different than a guy in engineering which is good. I think I help the group in being different. I don’t think the idea that in our discussion everyone’s like oh you should act you should really really focus don’t worry about the paperwork stuff. Again-- why is it bad for someone to be bad at paperwork? Is it like that whole sexist secretarial, oh-- if the girl is doing paperwork in your group then clearly they’re being sexist towards her. And they’re not upholding this standard. If she’s good at paperwork, paperwork! is again, no one wants to do it, yet why do people go to business school to become accountants. It’s because it’s important. So to me the fact that like um I don’t know I guess sometimes throughout yeah I went to an all girls school so I’ve been hearing this for like 4 years of my life. You guys should definitely be more technical be improve your math skills and blah blah blah and definitely I want to improve my math skills not because I want to compete against people but I want to be able to understand things and be confident in myself. But the fact that, if because you are a girl and you just happen to be really good at organizing or planning or doing numbers or making nice spreadsheets-- That should not be an indication that you are failing.
And I will admit, the guys are more like techy and they're more like into it and we're more like the overseers.

They’d be like: Oh girls don't let them be like only do the organizational stuff.

If because you are a girl and you just happen to be really good at organizing or planning or doing numbers or making nice spreadsheets-- That should not be an indication that you are failing.
Questions?
Co-Constructing a Critical Cultural Paradigm for Diversity in Engineering

Focus on changing the parts of the system within our control

Focus away from the individual to the system and the culture

Focus on the change efforts that matter the most

Critical Cultural Paradigm
What do you have direct control (or influence) over that impacts disparities in engineering?
Within your area of control or influence, how can you focus attention on the system and culture rather than individuals?
Considering the cultural and systemic issues you’ve identified, what are the change efforts that would matter the most?

Answer regarding your own contexts:
Thanks for Participating!

Potential collaborations:
- Examining the culture of curricular or co-curricular settings
- Novel audio dissemination methods for promoting inclusive awareness
- Apply for upcoming workshop on Creating Cultures of Inclusion

Other Resources:

To contact me:
Stephen Secules
sseculles@fiu.edu
succeed.fiu.edu