



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.





Diversity in Engineering Paradigm



Critical Cultural Research



Examples of Work

Classroom Critical
Ethnography
Agency through
Narrative



Co-Constructing the New
Paradigm

Agenda

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

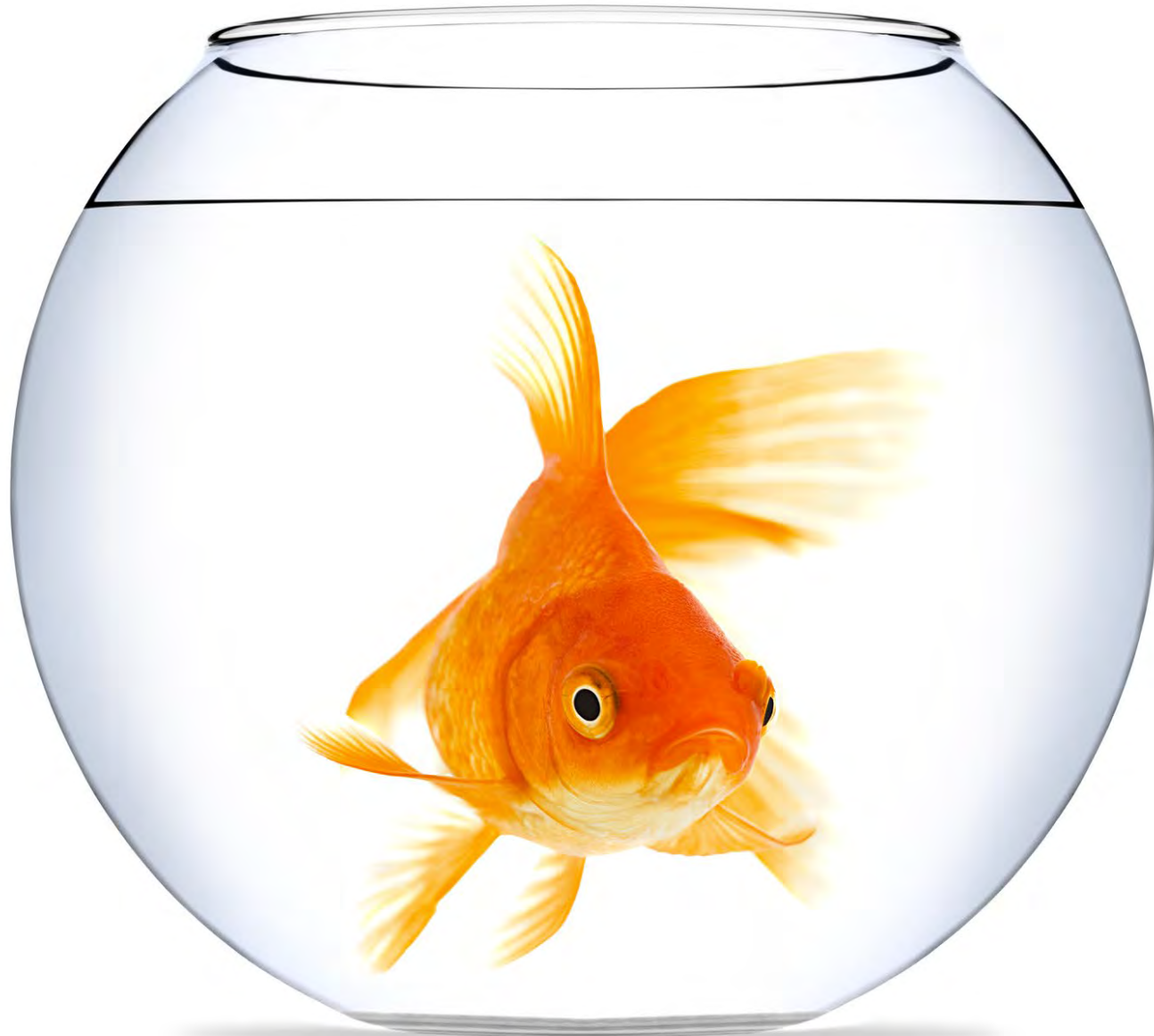
Root the problem in parts of the system **beyond our control**

- 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



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?



Classroom
Critical
Ethnography

Agency through
Narrative

Critical Cultural Research Projects



Classroom Critical Ethnography



- **Critical cultural study in an introductory programming course for undergraduate electrical engineers.**

Secules, S., Gupta, A., Elby, A., Turpen, C., (2018). Zooming Out from the Struggling Individual Student: An Account of the Cultural Construction of Engineering Ability in an Undergraduate Programming Class. *Journal of Engineering Education*

<https://doi.org/10.1002/jee.20191>



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.



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 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.

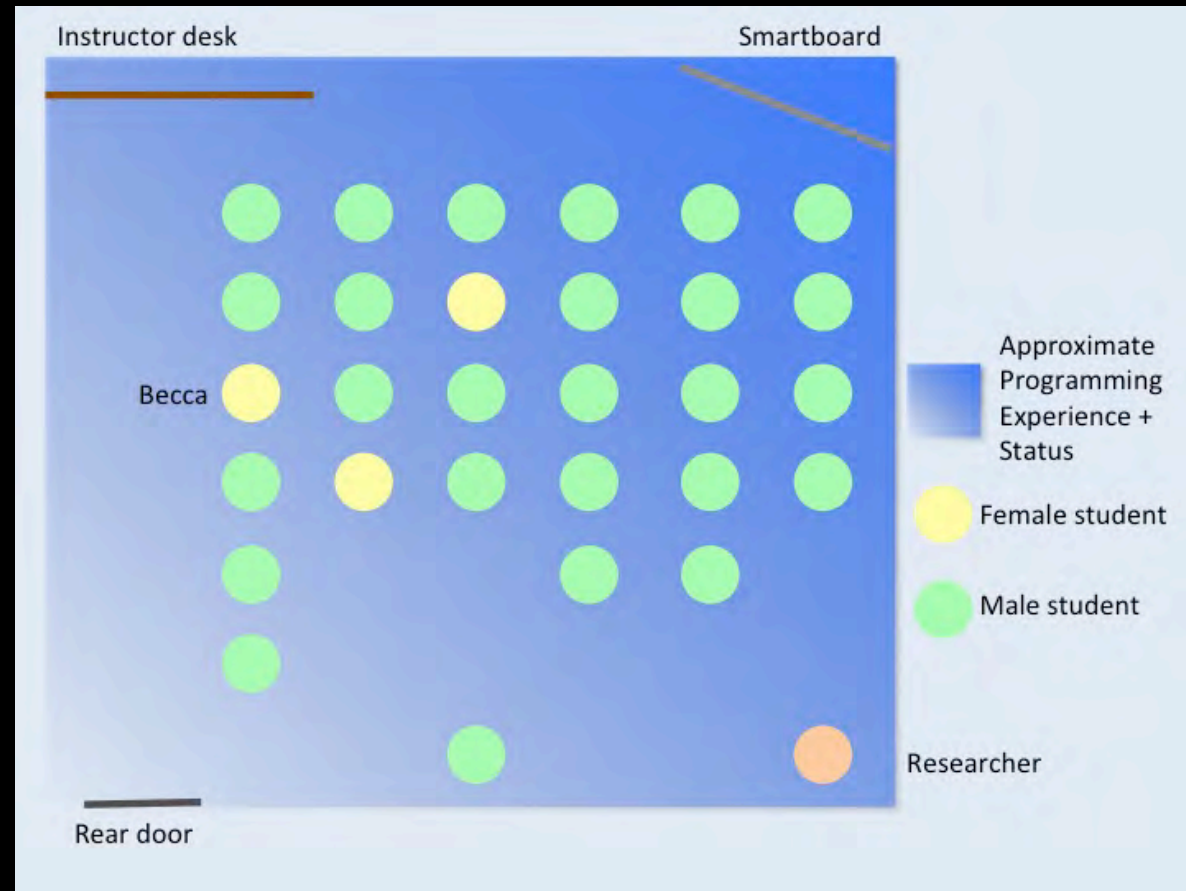


How did educational **culture** create the problem of “not cut out for” engineering?

Spotlighted social labels

Students perceived **status** in lecture seating choices.

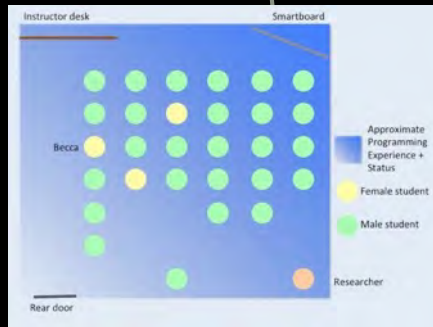
Lecture Classroom Culture



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.

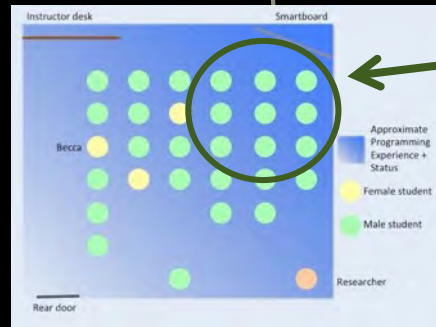
How do you react?



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

Spotlighted social labels

Status in seating choices



PowerPoint slide jargon

Programming-experienced students dominated classroom **discourse**.

Lecture Classroom Culture

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.

Laboratory Classroom Culture

Competition
Pressure



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 norms created a double bind for programming-inexperienced students:

Laboratory Classroom Culture

Competition
Pressure

*“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 secretorial, 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 overviewers.

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.

**Acknowledges
gender normative
team roles**

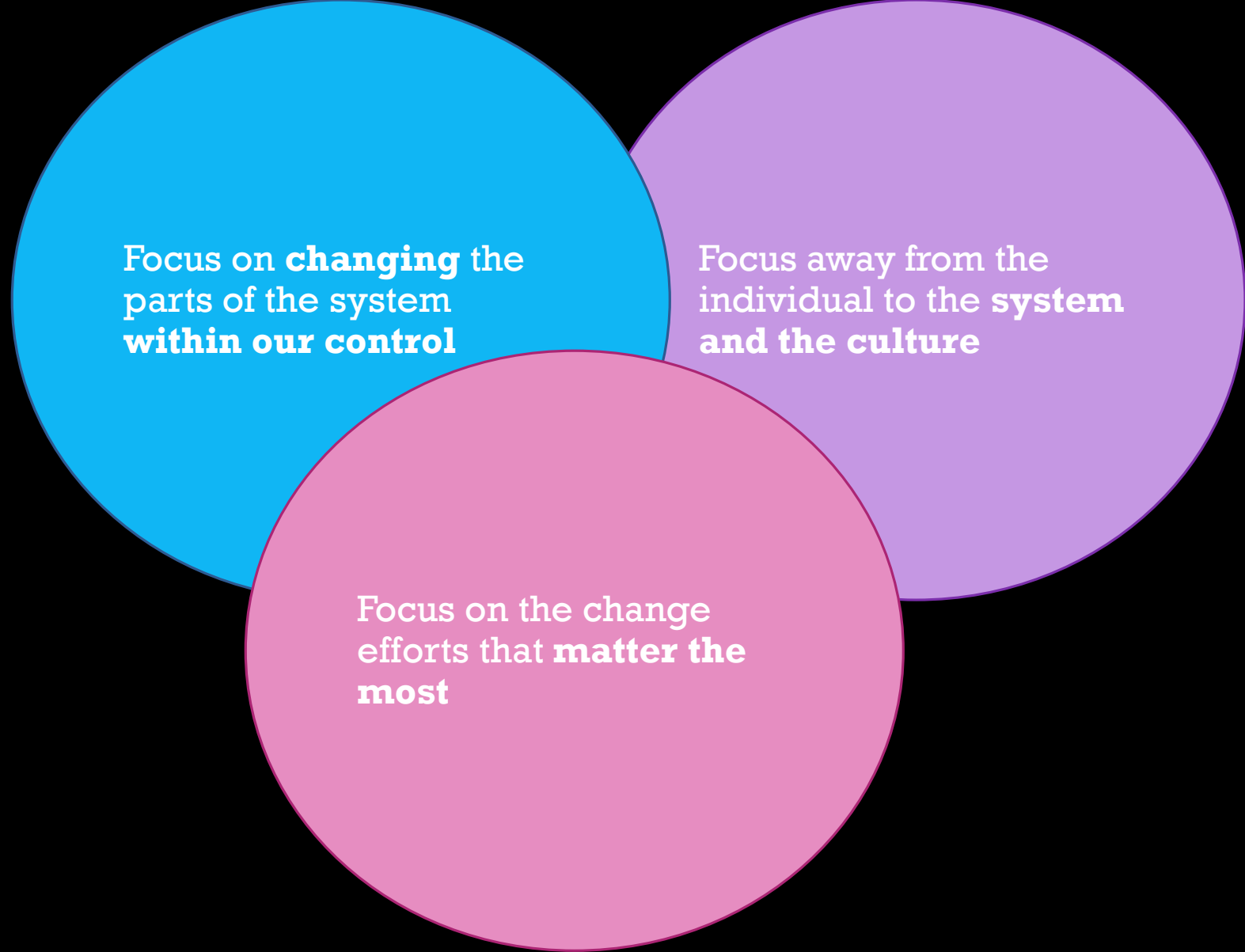
**Receives
empowerment
message to take
masculine roles**

**Critiques advice
via new narrative
valuing personal
gender-typical
strengths**



Questions?





Critical Cultural Paradigm

Co-Constructing a Critical Cultural Paradigm for Diversity in Engineering



Answer regarding your own contexts:

What do you have
direct control (or
influence) over that
impacts disparities in
engineering?



Answer regarding your own contexts:

Within your area of control or influence, how can you focus attention on the system and culture rather than individuals?



Answer regarding your own contexts:

Considering the cultural and systemic issues you've identified, what are the change efforts that would matter the most?



Thanks for
Participating!

To contact me:

Stephen Secules
ssecules@fiu.edu
succeed.fiu.edu

■ **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:**

- Secules, S. (2017). *Beyond Diversity as Usual: Expanding Critical Cultural Approaches to Marginalization in Engineering Education*. University of Maryland. <http://hdl.handle.net/1903/19445>
- Varenne, H., & McDermott, R. (1999). *Successful Failure: The School America Builds*. Boulder, CO: Westview Press.
- hooks, bell. (1994). *Teaching to transgress: Education as the practice of freedom*. New York: Routledge.
- Secules, S., Sochacka, N. W., & Walther, J. (2018). New Directions from Theory: Implications for Diversity Support from the Theories of Intersectionality and Liberatory Pedagogy. *The Collaborative Network for Engineering and Computing Diversity Conference*, (April). <https://peer.asee.org/29556>
- Secules, S., Lee, W., Boyd-Sinkler, K., Masters, A., Hampton, C., Taylor, A., & Grote, D. (2019). Dilemmas in Co-Curricular Support: A Theoretical and Pragmatic Discussion on Current Practice and Future Challenges. *Collaborative Network for Engineering and Computing Diversity* <https://peer.asee.org/31755>