EXAMINING THE DEVELOPING STEM ASPIRATIONS OF ADOLESCENT GIRLS AND THEIR IMPLICATIONS FOR EQUITABLE STEM TEACHING AND LEARNING

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Agenda

- Research Project Background
- Sources of Encouragement and Discouragement
- Understandings of Gender Inequality
- Implications for Equitable STEM Teaching and Learning

RESEARCH PROJECT BACKGROUND

Research Project Background

- Women are under-represented in STEM fields and particularly in engineering
- Large body of research on interest and entry to engineering
- Limited research centering the experiences of young women ***interested in pursuing engineering***

Research Project Background

- Collaborative, NSF-funded research project between SWE and researchers at UT-Austin on young women's engineering experiences
- ***SWENext program*** includes a sample of diverse high school girls from across the U.S.

Sources of Encouragement and Discouragement for High School Girls in SWENext

Background

- Support from parents, teachers, and peers are rarely considered ***together***
- Limited research on ***gender*** of source and ***how*** sources encourage and/or discourage girls
  - Yet, messages of inclusion and exclusion tend to be gendered

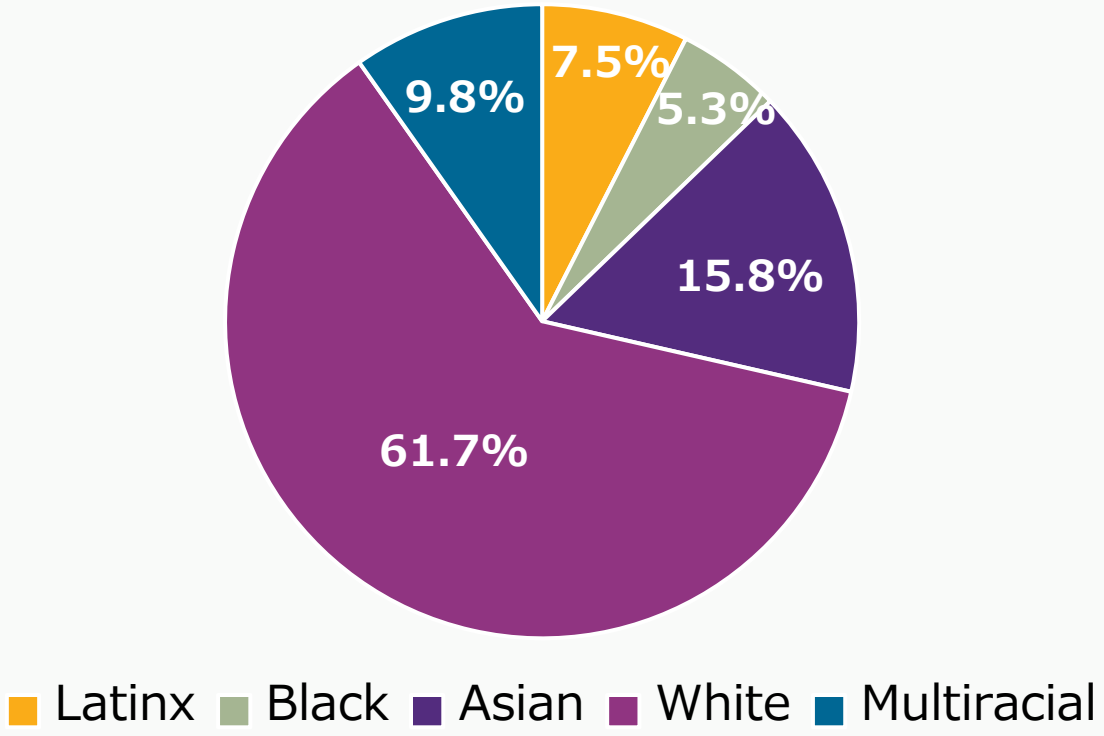
Research Questions

1. How are SWENext girls ***encouraged***?
2. How are SWENext girls ***discouraged***?

Methodology: Mixed-Methods Study

Quantitative component:

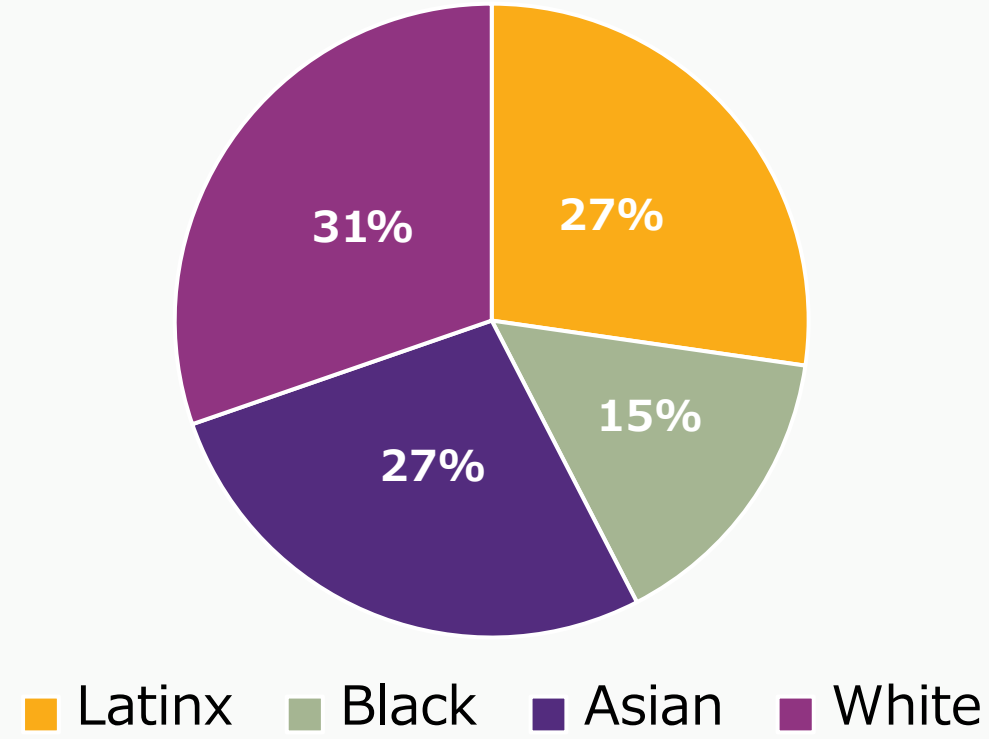
- Survey data (Spring 2019) from 133 SWENext high school girls
- Scale variables constructed from survey items that asked how much they ***"personally felt supported and encouraged to do well"*** in math, science, and engineering
  - Items ranged from 1 (*not at all*) to 5 (*a great deal*)
- Descriptive analyses



Methodology: Mixed-Methods Study

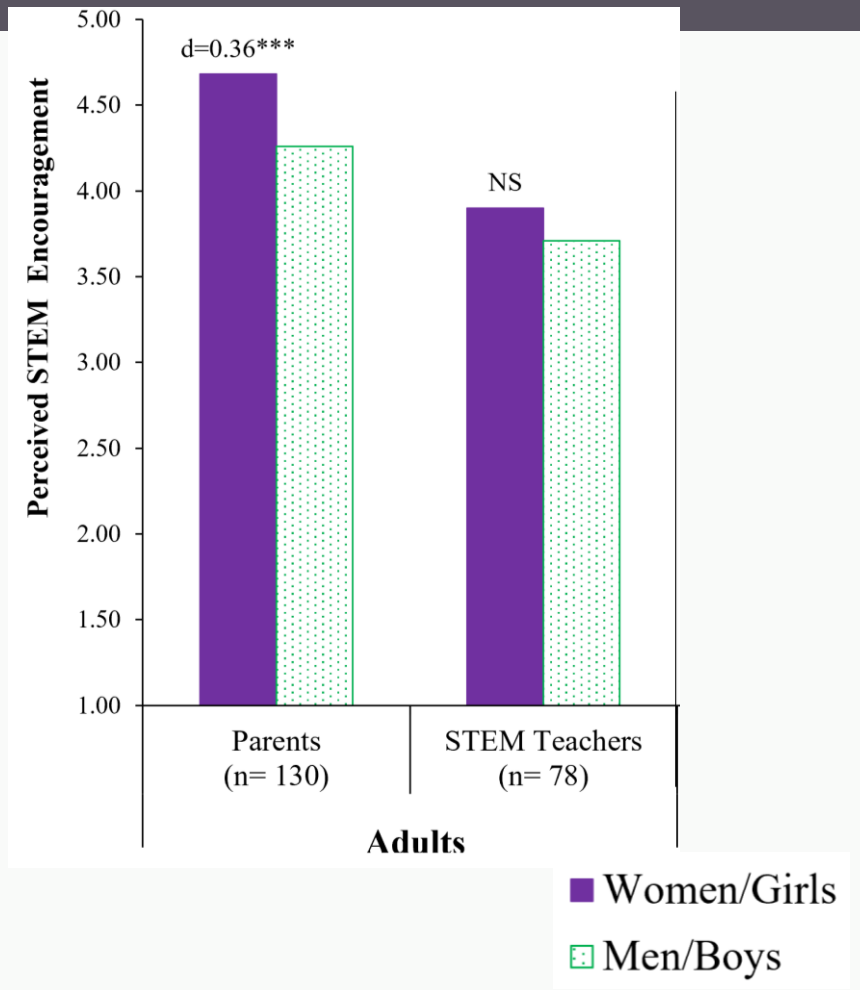
Qualitative component:

- In-depth, semi-structured interviews (Summer 2019) with 33 SWENext high school girls
  - 9 Latinx, 5 Black, 9 Asian, and 10 White high school girls
- Questions included asking girls to actively reflect on ***positive*** and ***negative*** experiences
- Thematic analysis (Braun & Clarke, 2013)



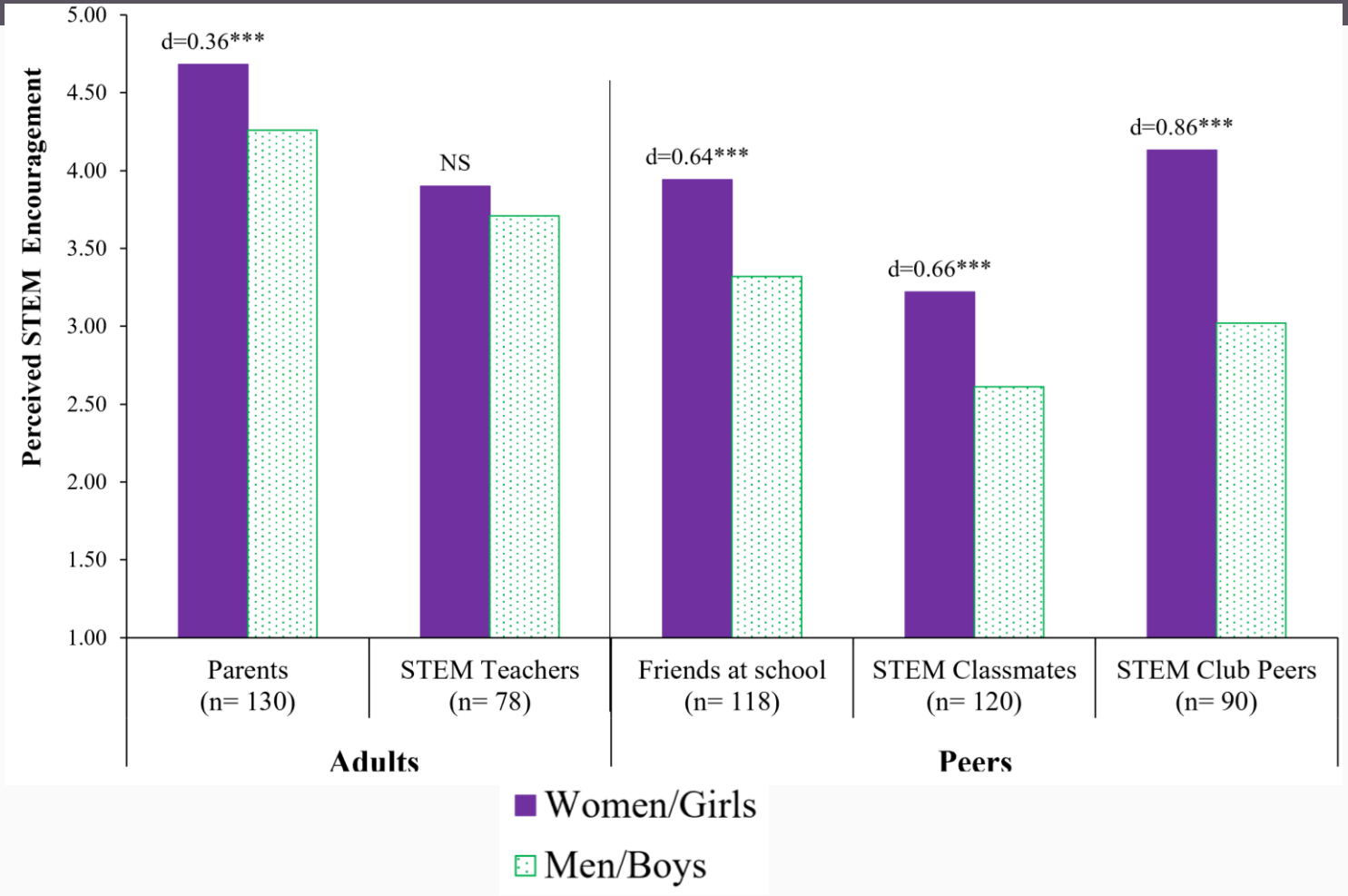
Findings

- Overall, SWENext girls reported high levels of support, particularly from adults
  - Small difference in support between fathers and mothers
  - No difference by teacher gender



Findings

- Overall, SWENext girls reported high levels of support, particularly from adults
- STEM encouragement was gendered among peers
- These patterns were similar across race/ethnicity



Findings

STEM encouragement described as:

- ***Pushing and advocating for SWENext adolescent girls***
- ***Providing academic assistance or mentoring***
- ***Recognizing them as capable of becoming engineers***
- ***Promoting their sense of belonging***

Recognizing them as capable of becoming engineers

“For a while I was the only girl on the team...My teacher really noticed how I was working with different groups at school. **He saw me as a natural leader and someone who could bring more girls into our program.** It just developed from there.”

-Olivia, White, 11th grade

Recognizing them as capable of becoming engineers

Promoting their sense of belonging

“Well, my friend—she started the robotics team two years earlier than she was supposed to because she had a parent that helped out with the team. She was allowed to hang around and get more involved. She suggested that I should join because it not only is about creating a robot from the start, **it's just more than that. It's like creating a bond with other people and creating bonds with other teams.**”

-Aliyah, Black, 9th grade

Promoting their sense of belonging

What about discouragement?

Findings

STEM discouragement was also gendered, and young men are the **only** source of discouragement across various STEM peer contexts

Findings

Themes that described how young men discouraged young women in STEM included:

- ***Social exclusion***
- ***Physical exclusion***
- ***Exclusion from idea ownership or engineering identity***

Social exclusion: High school boys ignoring and avoiding girls

“The **guys would get really insecure** if they weren't better at math or science than some of the girls... they would almost bully the girls because they made them feel bad about their own ability [···] a lot of the talk... around a lot of girls who were interested in STEM was like a lot of guys have the idea that **if the girl is smarter than them**, it automatically makes her not less than, but not cool to be around, or like **undesirable as a person**.”

-Kiara, Black, 12th grade

Social exclusion: High school boys ignoring and avoiding girls

Physical exclusion: High school boys asserting ownership of physical space and materials

"Most of the time **they never let me actually do anything hands-on** with the robot. They gave me the role as a writer for our engineering notebook. I **wasn't actually directly doing any software development or doing any building**...I really wanted to leave that role after my freshman year 'cause that wasn't what I signed up for when I wanted to do robotics. **I wanted to do the hands-on engineering and building and problem solving with the robot**."

-Jaya, Asian, 11th grade

Physical exclusion: High school boys asserting ownership of physical space and materials

Exclusion from idea ownership: High school boys taking credit for girls' ideas

“Sometimes, I don’t know, it feels weird when you’re working with a group of boys, and some boys are not as nice maybe. I have experienced something when I’m in a group work, and then I say something, and it sometimes feels like they didn’t really process what I said, **but then this other guy says something similar, and then they’re like, ‘Oh, yeah, that’s right.’ I’m like, ‘Whoa, I just said the same thing.’** That really happens when you’re in a group where all the boys are like a little groupie, and **you’re kind of like the intruder girl** in their group.”

-Emily, Latinx, 11th grade

Exclusion from idea ownership: High school boys taking credit for girls’ ideas

Does peer encouragement predict young women's engineering identity and major intentions?

Findings

- STEM support from girl peers was significantly associated with SWENext high school girls' strong identification with engineering
- Similarly, SWENext girls who report higher levels of STEM support from girl peers SWENext girls have a stronger intention of majoring in engineering
- In contrast, boys' STEM support was not associated with SWENext girls' strong engineering identity nor their strong intention to major in engineering.

SWENext High School Girls' Understandings of Gender Inequality

Background

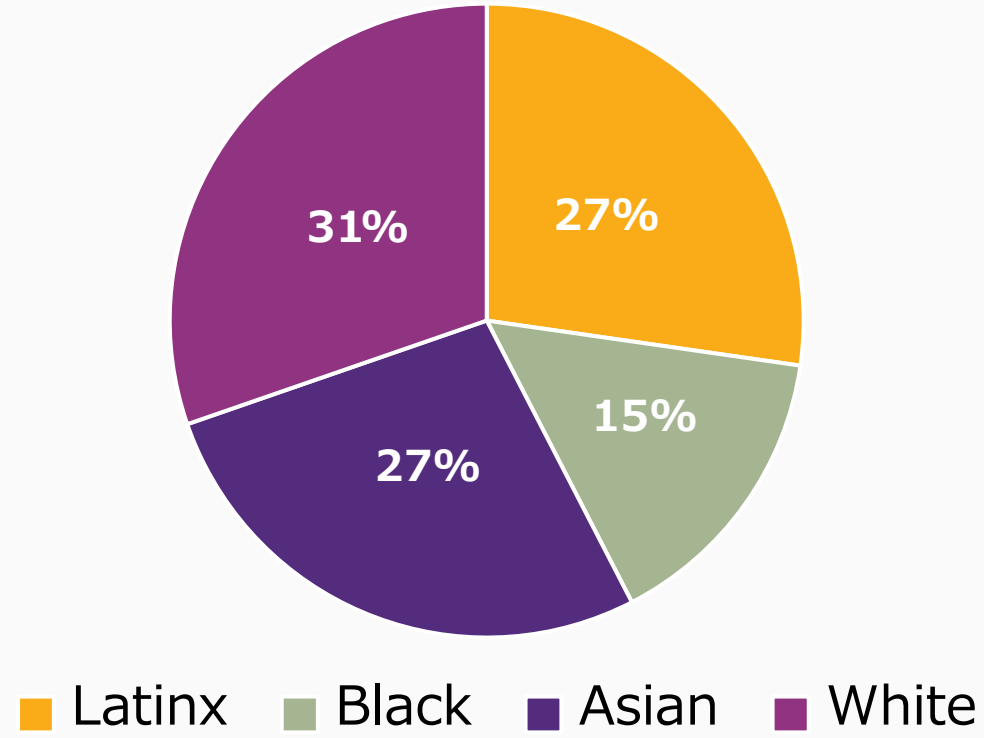
- Limited research on women's understandings of gender inequality in STEM fields
  - Even less research on viewpoints of ***adolescent girls*** with STEM aspirations
- Importantly, the use of an intersectional approach is necessary to explore the engineering experiences of diverse young women

Research Questions

1. How do SWENext girls ***make sense*** of women's under-representation in engineering?
2. How do they ***anticipate dealing with*** gender inequality in their ***future careers***?

Methodology: Qualitative Study

- In-depth, semi-structured interviews (Summer 2019) with 33 SWENext high school girls
- Questions included asking their thoughts on ***women's under-representation*** in engineering and how this would ***affect them in the future***
- Thematic analysis (Braun & Clarke, 2013)



Findings

Systemic understanding of women's under-representation in engineering refers to an awareness of gender inequality as being connected to societal stereotypes about gender

Findings

Systemic understanding of women's under-representation in engineering refers to an awareness of gender inequality as being connected to societal stereotypes about gender

- More than half of SWENext participants (55%) expressed a systemic understanding of gender inequality
- Black young women were more likely to articulate such systemic understandings of gender inequality

Systemic understanding of gender inequality

“[T]he engineering program I'm going to go into next year is mainly male, I think that having that disadvantage of your gender is going to have an impact because there is **already the stereotypes that women aren't as good at engineering or at technology as men** [···] I think 'cause, as a society, it started off with males are more important than females. Especially in America, **the males’ influence is what drives the country**... that really is what pushes males to feel more inclined to have their opinion be heard, **their opinion is the one that's correct when it's not necessarily true**. I think it's 'cause **they've always gone in that position of power in comparison to women**.”

-Lisa, Asian, 9th grade

Systemic understanding of gender inequality

Systemic understanding of gender inequality

"There is definitely **societal norms** around certain types of professions, certain types of interests, certain types of jobs...**Some women have been told through media and things like that, that they are inferior or unable to do certain things**. They internalize that, and then they think that it's true. **I think that's a big reason why there's not as many women in these positions**...I think it's also women holding themselves back because of the way they can possibly be treated—just because of hearing things that have happened to other women who have had to not conform to what society is telling them to do. I think that it's disheartening, and **makes some women draw themselves back and not show their full potential even if they have interests**."

-Brianna, Black, 11th grade

Systemic understanding of gender inequality

Findings

About a third of young women (34%) expressed a ***"lean-in" self-confidence,*** or confidence in their ability to *navigate* engineering to be *personally* successful

- Most White young women expressed a "lean-in" self-confidence

“Lean-in” self-confidence

“[The college I will be attending] has a 30:70 girl guy ratio, maybe a little higher, but it wasn’t a turn off for me ‘cause, I don’t know, I’m one of the few people who doesn’t care, I’ll make friends regardless of who they are. **I think because I’ve had that experience of being the only girl in a guy’s class, I can handle it**. I’m very okay with it **... I don’t think about it on a daily basis like, ‘I’m the only girl and I’m going into a male oriented field**.”

-Elizabeth, White, 12th grade

“Lean-in” self-confidence

Findings

Only six young women (19%) articulated ***critical self-confidence,*** or confidence in their ability to *change* the male-dominated culture of engineering

- Again, Black (and Latinx) young women were more likely to express such critical self-confidence

Critical self-confidence

"**Wherever I end up, I'm gonna make space for all women who would like to join** [···] When I'm the only girl in class, I know that sometimes I'm going to be the only girl that these boys are probably gonna meet for a while... I try my hardest to... make room for other women that are gonna come after me. I'm not timid about talking about things. I try to help out the guys get comfortable with having a girl around [···] **If there's other girls gonna be after me, I want them to feel comfortable talking about stuff**. I feel like **I try to educate men who are in the same room as me in hopes that they will be the ones to help out if they're ever in the scenario as well**."

-Carla, Latinx, 12th grade

Critical self-confidence

Implications for Equitable STEM Teaching and Learning

Significance and Implications

STEM educators:

Create more gender-equitable STEM learning environments:

- Facilitate intergroup dialogues focused on addressing gender inequity in STEM
- Intentionally position young women in leadership roles
- Teach young men to recognize the contributions of young women and call attention to their exclusionary behaviors

Significance and Implications

STEM teacher educators and other stakeholders:

- Listen to ***lived experiences*** of minoritized learners in STEM to co-construct more inclusive STEM learning environments
- Support the development of a ***systemic understanding of gender inequality*** in ***all*** people (e.g., future teachers) as well as ***critical self-confidence*** rather than “lean-in” self-confidence for addressing gender inequality

Changing the gendered status quo in engineering? The encouraging and discouraging experiences of young women with engineering aspirations

THANK YOU

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Critical Consciousness of Gender Inequality: Considering the Viewpoints of Racially Diverse High School Girls with Engineering Aspirations

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