ASEE AMERICAN SOCIETY FOR ENGINEERING EDUCATION

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Breaking Barriers: Unveiling the Journeys and Triumphs of Faculty Women of Color in STEM Academia

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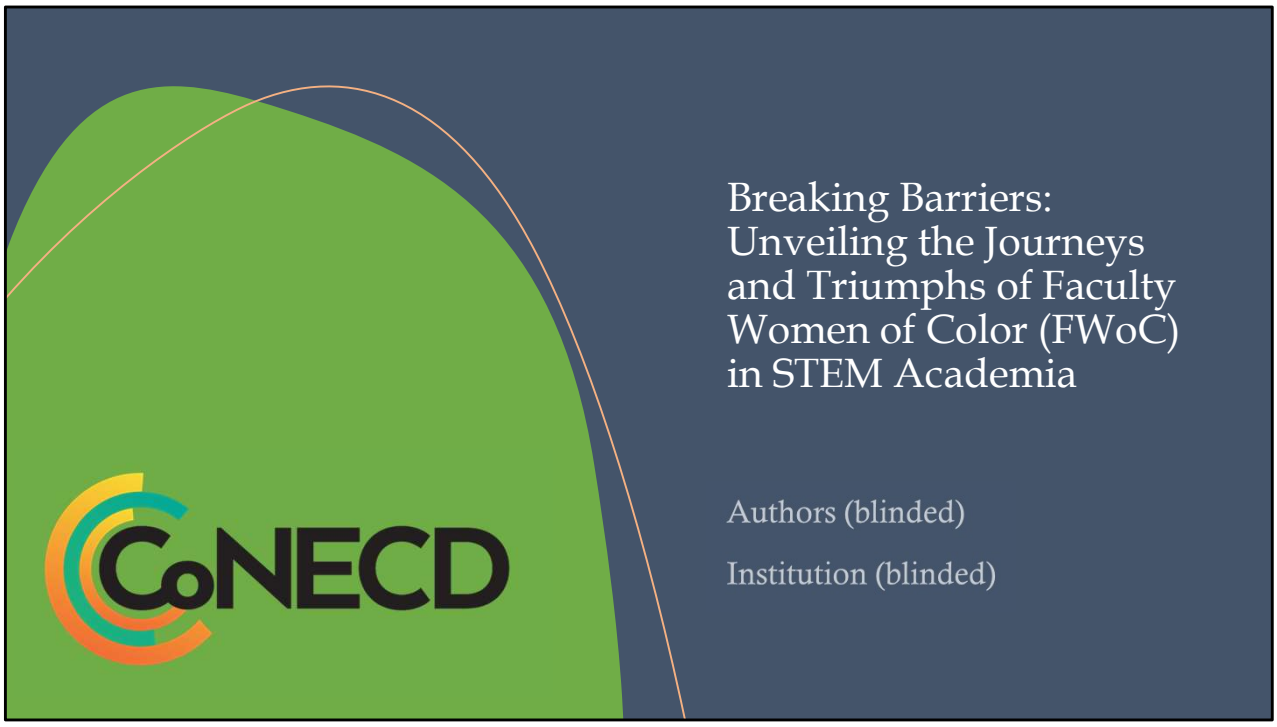
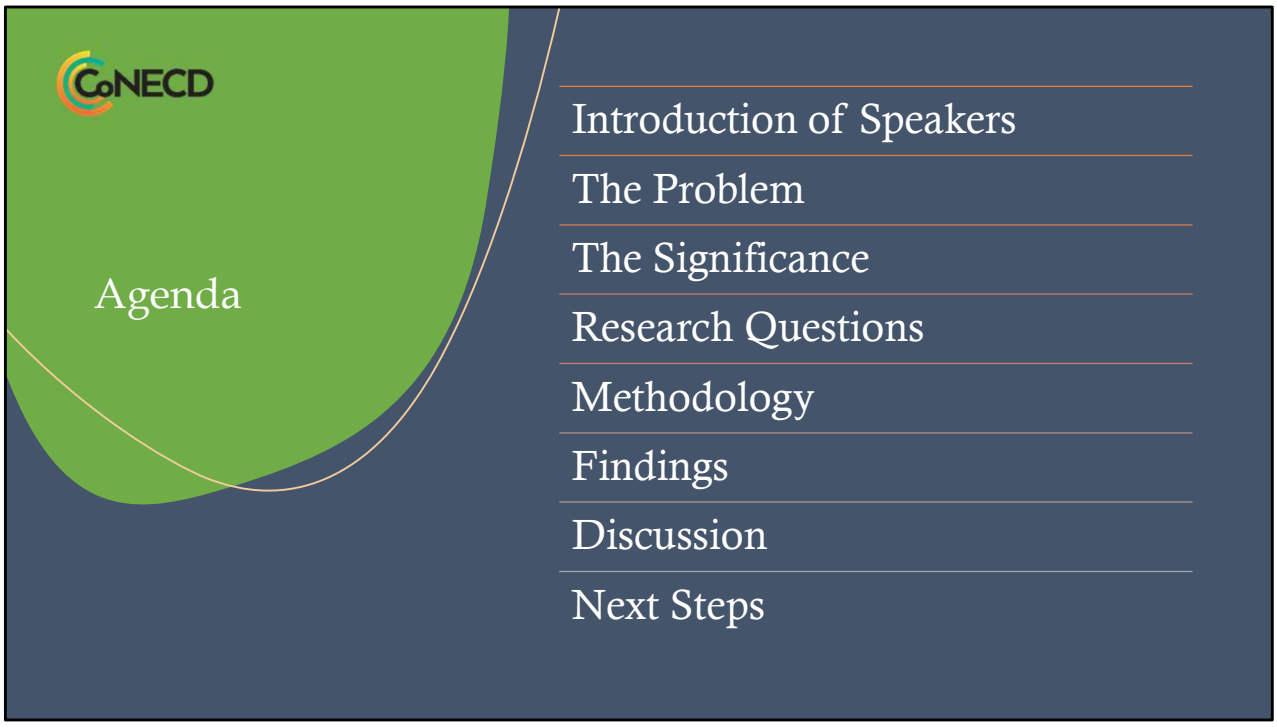
Dr. Kemesha Gabbidon is an Assistant Professor in the Department of Psychology at the University of South Florida. Her scholarly interests include youth sexual health and health equity. Her research is theoretically grounded and applies an intersectional lens to investigating socio-political, cultural, and psychosocial influences on the health of the individual and their community. Dr. Gabbidon has published on pediatric HIV, HIV stigma, and culture and sexuality. Her current research is aimed at investigating intersectional stigma and how it affects HIV-related outcomes in Tampa Bay by applying participatory qualitative methods. Dr. Gabbidon also teaches graduate and undergraduate courses in Psychology including Cultural Competence, Program Evaluation, and Health Psychology.

Dr. Saundra Johnson Austin, University of South Florida

Dr. Saundra Johnson Austin has dedicated her career to promoting diversity, equity, inclusion, and belonging of students and professionals in science, technology, engineering, and mathematics (STEM) education and careers. Her research is grounded in the effective implementation of STEM curricula in urban middle schools. Johnson Austin began her career at Bechtel Power Corporation as a cost engineer. She has held leadership positions in the secondary, post-secondary, non-profit, industry, engineering public policy, and community development sectors. She is currently the Special Assistant to Dr. Sylvia Wilson Thomas, the University of South Florida's Vice President for Research and Innovation, and President and CEO of the USF Research Foundation. Dr. Johnson Austin received the 1998 NSBE Inaugural Golden Torch Award for Minority Engineering Program Director of the Year, the NAMEPA Outstanding Contribution by a Minority Engineering Program Administrator Award, and the 2015 Outstanding Engineering Alumnus for Civil and Environmental Engineering from The Pennsylvania State University. She is a member of the U.S. White House endorsed initiative Algebra by 7th Grade, the Commission for Diversity, Equity and Inclusion to ASEE MIND, the Smithsonian Science Education Center's Advisory Committee for 'Zero Barriers in STEM Education,' board member for the Northeast STEM Starter Academy of Mount Vernon, NY, and the Florida-based STEM Xposure. She earned a BS in Civil Engineering from The Pennsylvania State University, an MBA from the University of Notre Dame, and a Doctor of Education in Organizational Change and Leadership from the University of Southern California.



Welcome audience and introduce presentation

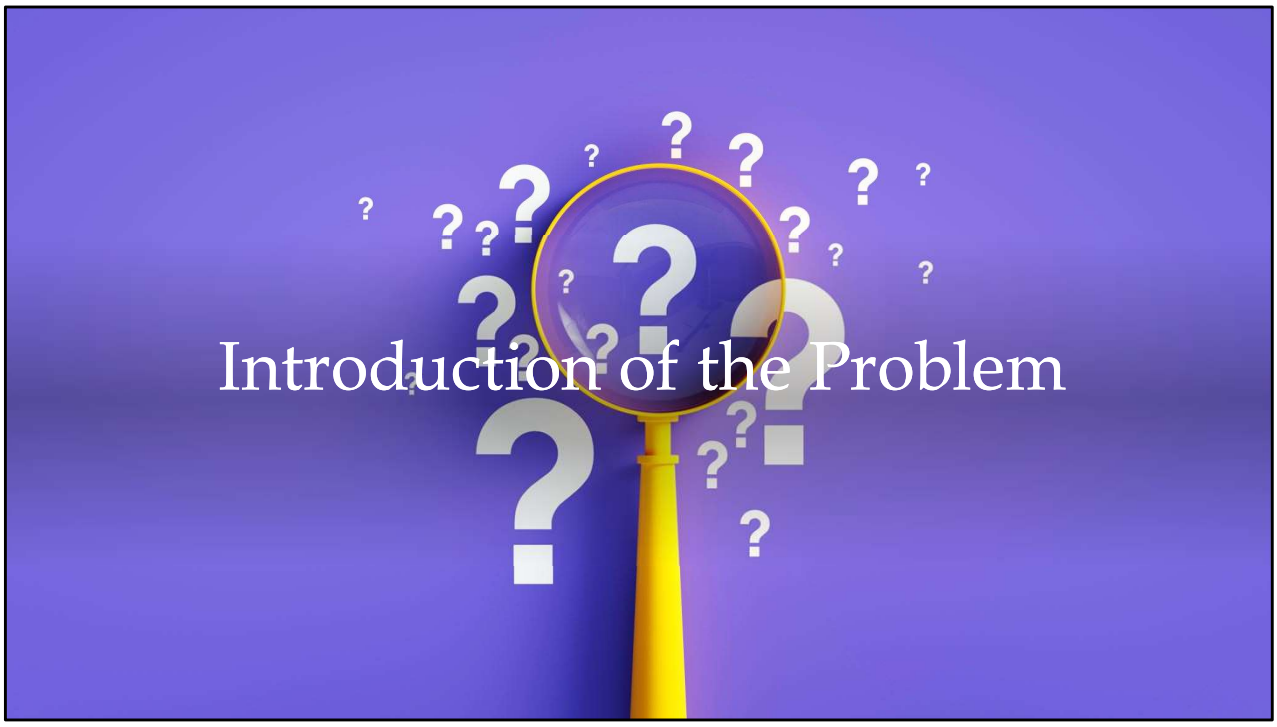


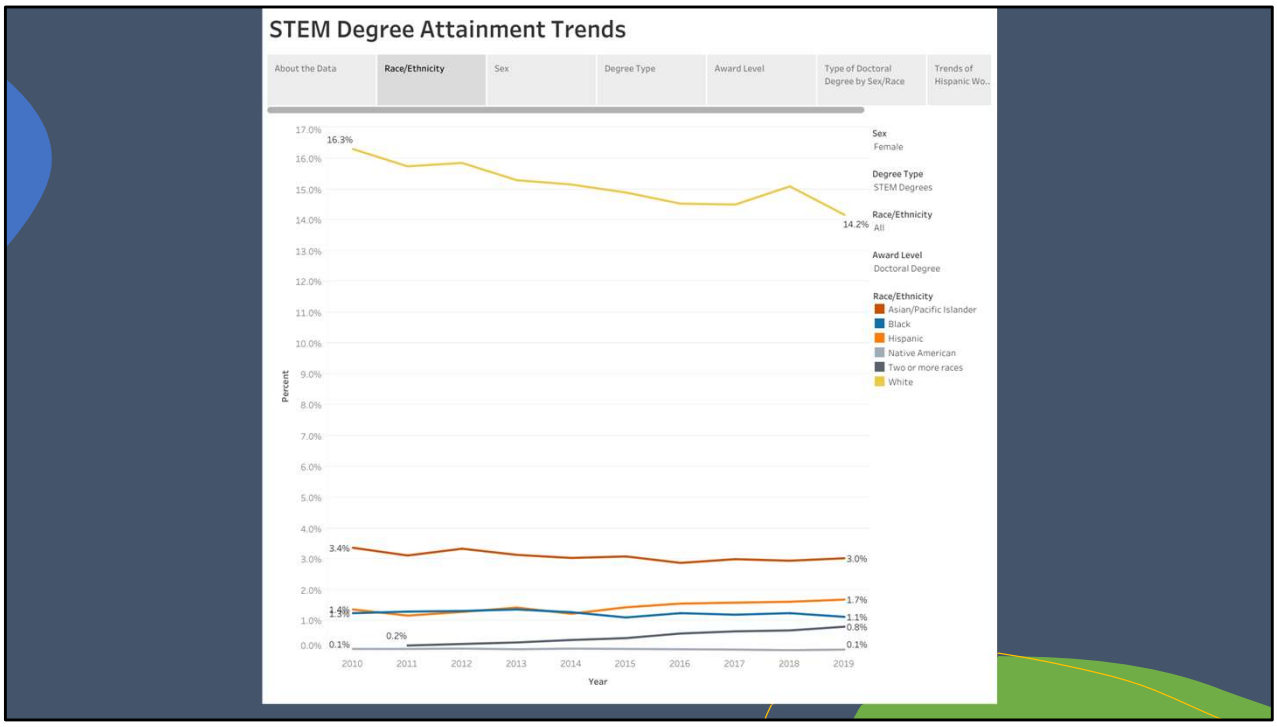
Briefly review agenda

Speakers

Each speaker will introduce themselves [Name, position, academic training]

Archival Publication Authors Workshop

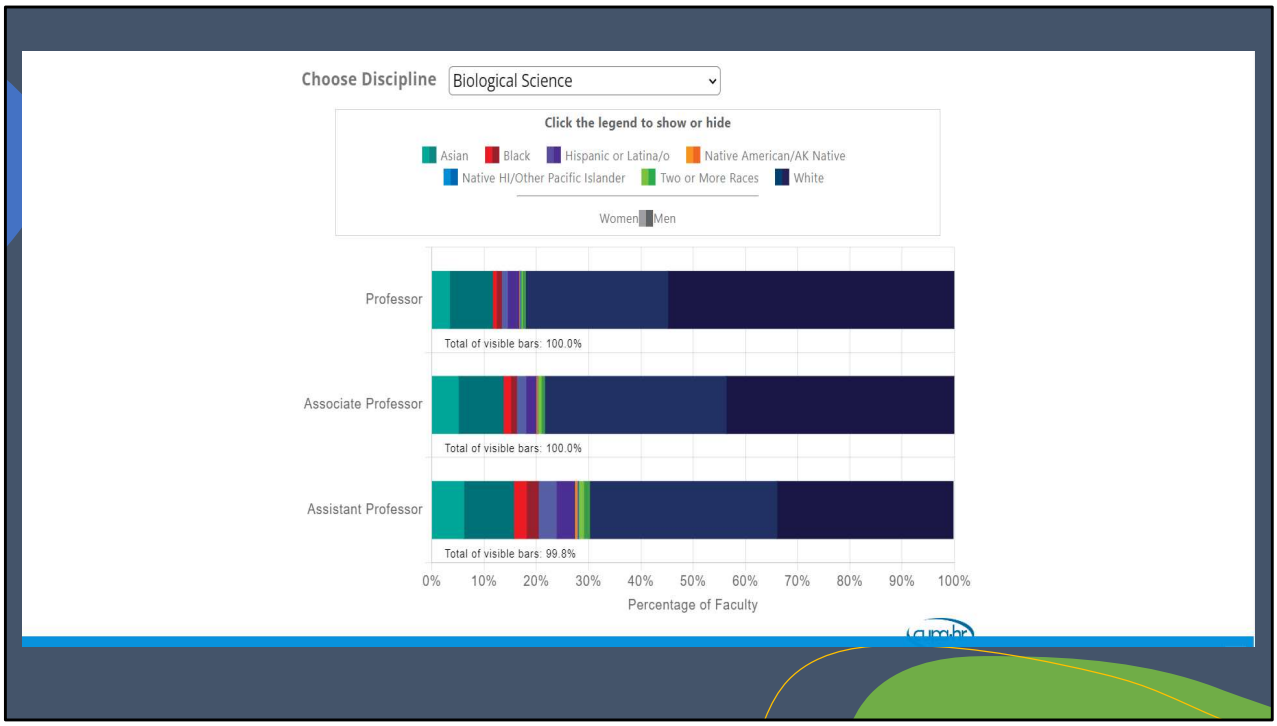

Introduction of the Problem



- Women account for significantly less STEM degrees than men and among women, there are racial/ethnic divides.

- This image reflects data collected from 2010 and 2019 through the National Center for Educational Statistics and show discrepancies in the acquisition of STEM doctoral degrees with 14.2% among White women compared to 3.0% among Asian women, 1.7% among Hispanic women, 1.1% among Black women, 0.8% among bi- and multiracial women, and 0.1% among Indigenous women.

- Authors: Wright, B., Gunther, O., Bitar, J., & Ilano, L.
- link: https://edtrust.org/blog/why-stem-equity-must-address-the-experiences-of-women-of-color/



- In addition to the lower STEM degree attainment trends, we see disparities in in academic STEM professional rank differences. We selected three STEM fields (biological science, engineering, and mathematics) but do note that the trends are similar for other areas of STEM.
- First, note that each racial/ethnic group displayed has lighter and darker shades to show sex-related differences with darker colors referencing males from that racial group. For every group, men outpace women in moving through the ranks.
- Next, we see that White academicians outpace all racial/ethnic groups, and finally, we see a steady decline as professors advance through the ranks.
- Specifics on slide:
    - Assistant professor: White men 54.8% White women – 33.%; Two or more races men – 1.1% /Two or more races women 0.6%; Native American men 0.2%, Native American women 0.1%; Pacific Islander men 0.1; Pacific Islander women 0.2%; Latino 3.5%; Latina – 1.1; Black men 2.3%/Black women .8% and Asian men – 9.5%, Asian women 3.4%
    - Associate professor: White men 43.6%, White women 27.2%; Two or more races men .6% Two or more races women .6%; Native men and women 0.1%; Latina 1.8% Latino 2.2%; Black men 1.1% Black women .8%; Asian men 8.6% Asian women 3.4%.
    - Full Professor: White men 54.8% White women 27.2%; Two or more races men

.6%/Two or more races women 0.3%; Native Hawaiian women .1% Native Hawaiian men 0%; Pacific Islander men 0.2% Pacific Islander women 0.1%; Latino 2.2% Latina 1.1%; Black men 1.0% Black women 0.8% and Asian men 8.2%Asian women 3.4%.

Citation: Schneider, Jennifer & Bichsel, Jacqueline. (2024, April). *Representation and Pay Equity in Higher Education Faculty: A Review and Call to Action.* CUPA-HR. https://www.cupahr.org/surveys/research-briefs/representation-and-pay-equity-in-higher-ed-faculty-trends-april-2024/: https://www.cupahr.org/surveys/research-briefs/representation-and-pay-equity-in-higher-ed-faculty-trends-april-2024/

Engineering

- Assistant Professor: White men 34.8% White women 16.3%; Two or more races men and women 0.5%; Pacific Islander women 0.1%, Pacific islander men 0%; Latino 3.4% Latina 1.7%; Black men 2.0%, Black women 1.3%; Asian men 30.4% Asian women 8.8%.

- Associate professor: White men 44.8%; White women 13.3%; Two or more races men 1.1% Two or more races 0.2%; Native men 0.3% Native women 0%; Latino 3.6%, Latina 1.2%; Black men 2.3%, Black women .8%, Asian men 27.3% Asian women 6.0%.

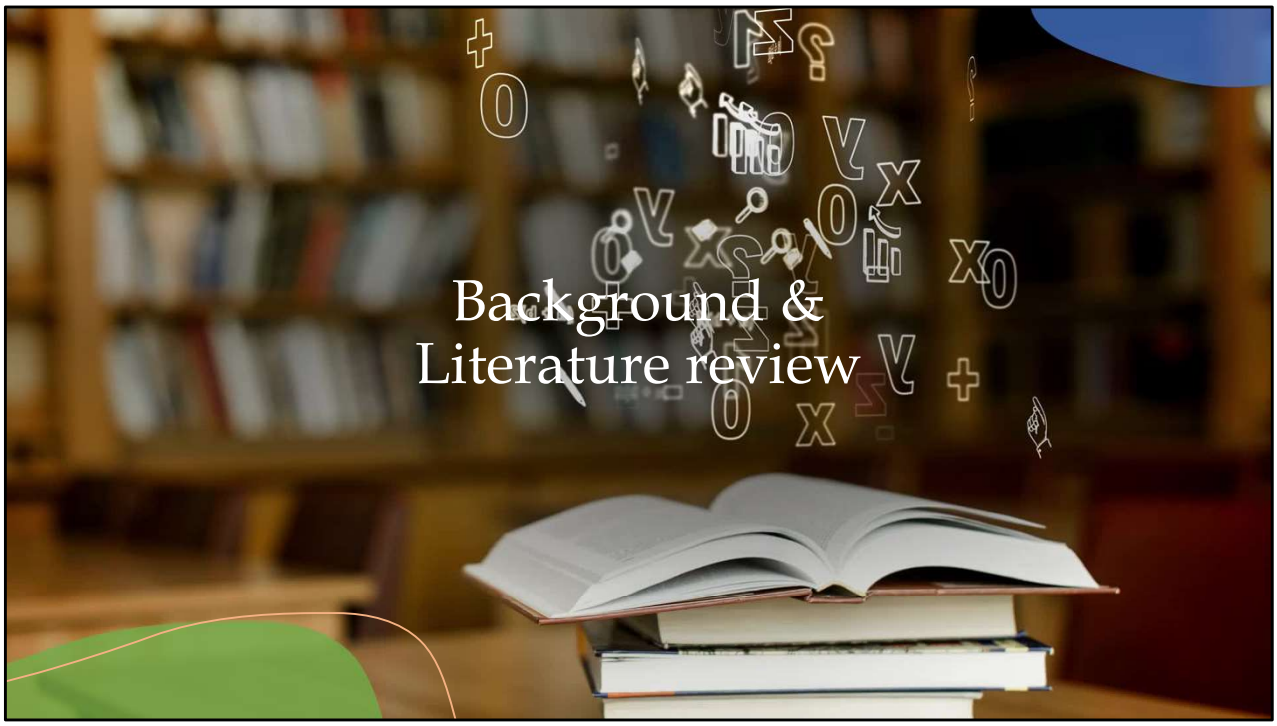
- Full Professor: White men 52.3%, White women – 8.4%; Two or more races men 0.5% Two or more races women 0.2%; Native men 0.1% Native women 0%; Latino 2.6% Latina 0.7%; Black men 2.1% Black women 0.2%; Asian men 28.6% Asian women 4.1%.

Mathematics

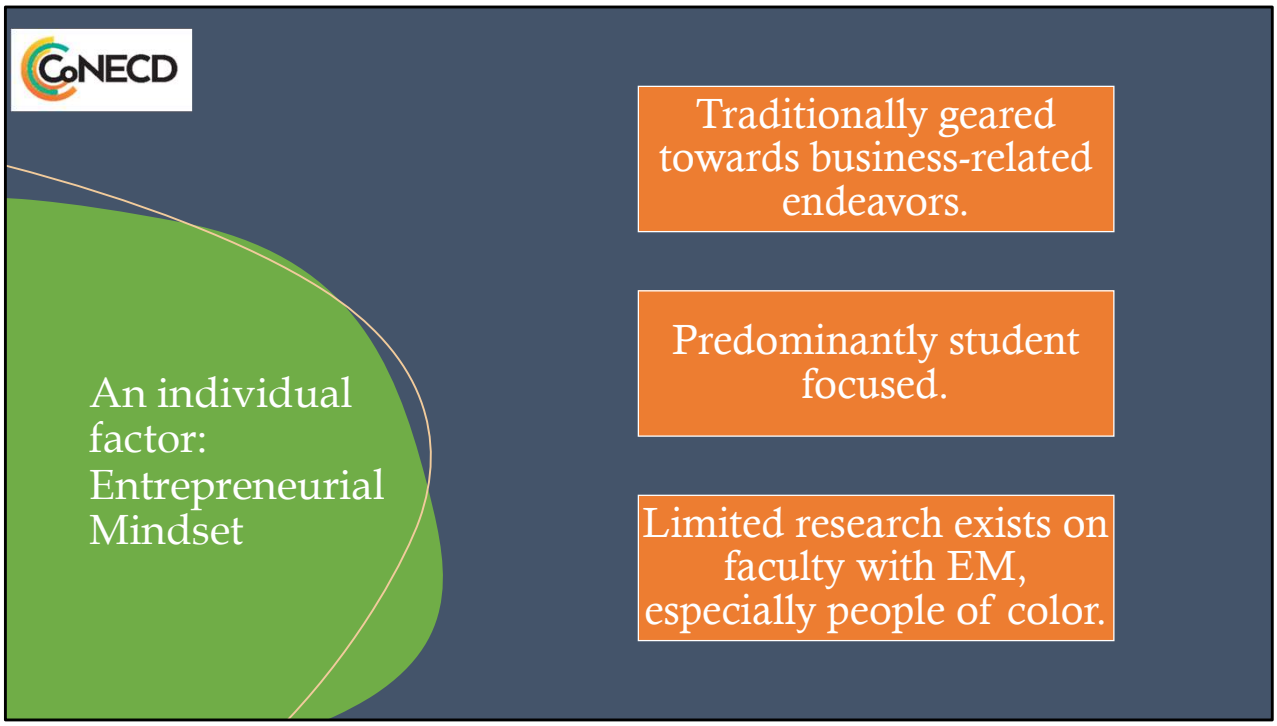
- Assistant professor: White men 39.6%, White women 23.2%; Two or more races men 0.4% two or more races women 0.1%; Pacific Islander men 0.3%, Pacific Islander 0%; Latino 2.8% Latina 1.2%; Black men 3.6% Black women 1.9%; Asian men 15.6% Asian women 11.2%.

- Associate professor: White men 46.1% White women 24.1%; Two or more races men 0.3% Two or more races women 0.1%; Pacific Islander men 0.1%, Pacific Islander women 0%; Latino 2.8%, Latina 1.2%; Black men 2.1%, Black women 1.3%; Asian men 14.2%, Asian women 7%.

- Full Professor: White men 53.4%, White women 18.8%; Native men 0.3% Native women 0%; Two or more races men 0.3% two or more races women 0.1%; Latino 2.2%; Latina 1.2%; Black men 1.8% Black women 0.4%; Asian men 16.3%, Asian women 4.8%.



What do we currently know about how FWoC in STEM achieve success including individual and systemic factors.



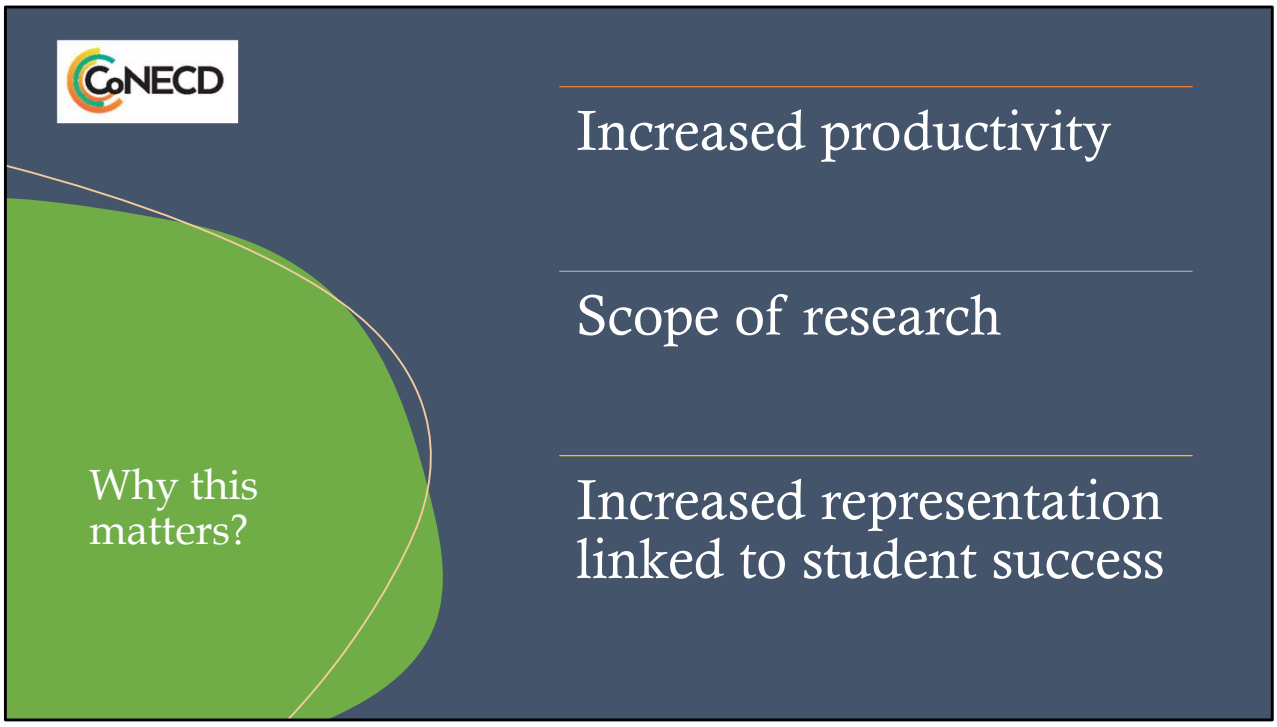
- Individual level factors – these are factors specific to a person that contributes to their success and in STEM we came across the concept of Entrepreneurial Mindset (EM).
- Although traditionally geared towards business-related endeavors, EM can foster success in STEM fields as well.
- Often, EM-related courses are taught to students in STEM to supplement their technical knowledge with skills to address career endeavors (i.e., having the motives, skills, and thought processes to succeed outside of content training) (Bossman & Phillips, 2022; Erdil, 2020; Gorlewicz & Jayaram, 2020; Harichandran et al., 2018; Vijayan et al., 2024).
- Another important factor of EM is that it can be learned and thus is open to intervention and development.
- Further, with EM 85% of publications are by American scholars with a predominantly white American lens, thus an exploration of its role among women of color in STEM is warranted.

- A synthetic review by Naumann (2017) showed that all definitions of EM covered thinking as a core feature, thus making EM a cognitive perspective.
- In their synthetic review, Naumann noted that no single concept of EM was considered universal and thus there was no uniformity among definitions. However, Naumann believed that there should be a focus on the cognitive aspects of EM and its metacognitive components. Thus, we were interested in a definition that clearly captured both skills and thought processes and landed on the Davis definition to use in our study. Later, we broadened the subcategories of motives, skills, and thought processes to capture the nuances often reported along with EM.

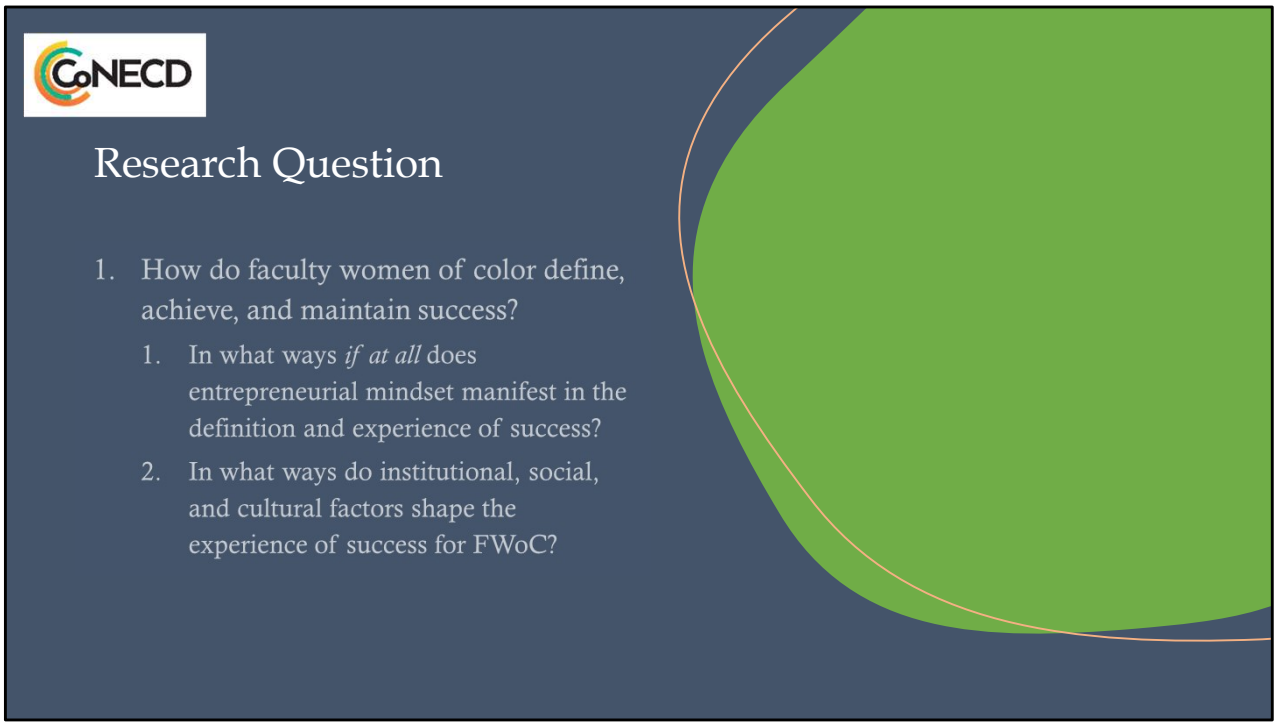
Institutional and Systemic Factors

- Institutional support is key to fostering inclusive and empowering environments for FWoC and students (Diggs et al., 2023; Grant and Ghee, 2015)
- Social and environmental factors (Alfred et al., 2019)

- Institutional:
  - Domingo et al. (2022) identified 3 institutional barriers to FWoC success: (1) "inequitable distribution of service with no reward; (2) devaluing of service by the university; and (3) lack of clarity and consistency about the role of service in the retention, tenure, and promotion (RTP) processes"
  - Mentorship and support is key to FWoC success (Diggs et al., 2023; Grant and Ghee, 2015).

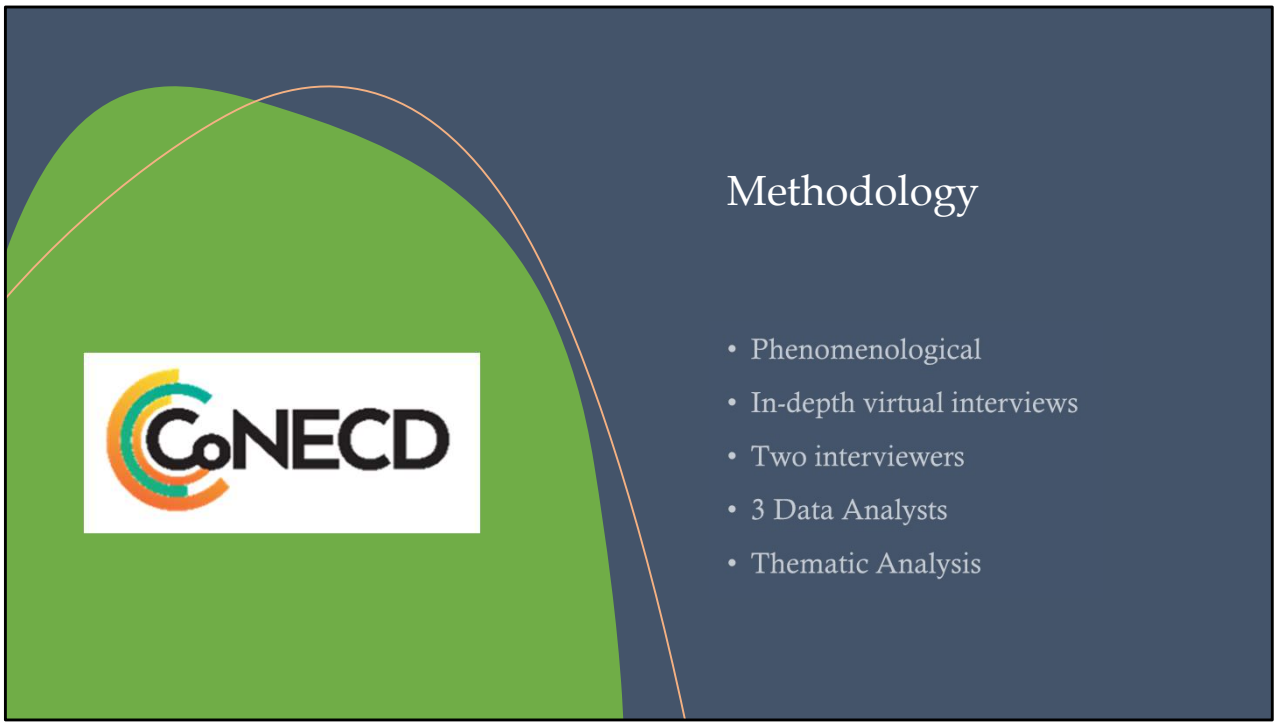


- FWoC are integral to the academic landscape, enriching higher education with their diverse perspectives and invaluable contributions to diversity, equity, and inclusion.
- As scholars, educators, and leaders, they navigate a complex interplay of factors that influence their definitions of success and pathways to achievement. Understanding the complex interplay of personal, institutional, and sociocultural dynamics is paramount in illuminating their experiences. Which by understanding and addressing will ultimately resulted in increased productivity, broadening the scope of research undertaken in STEM fields, and improving students' success by enhancing student's feelings of belongingness.



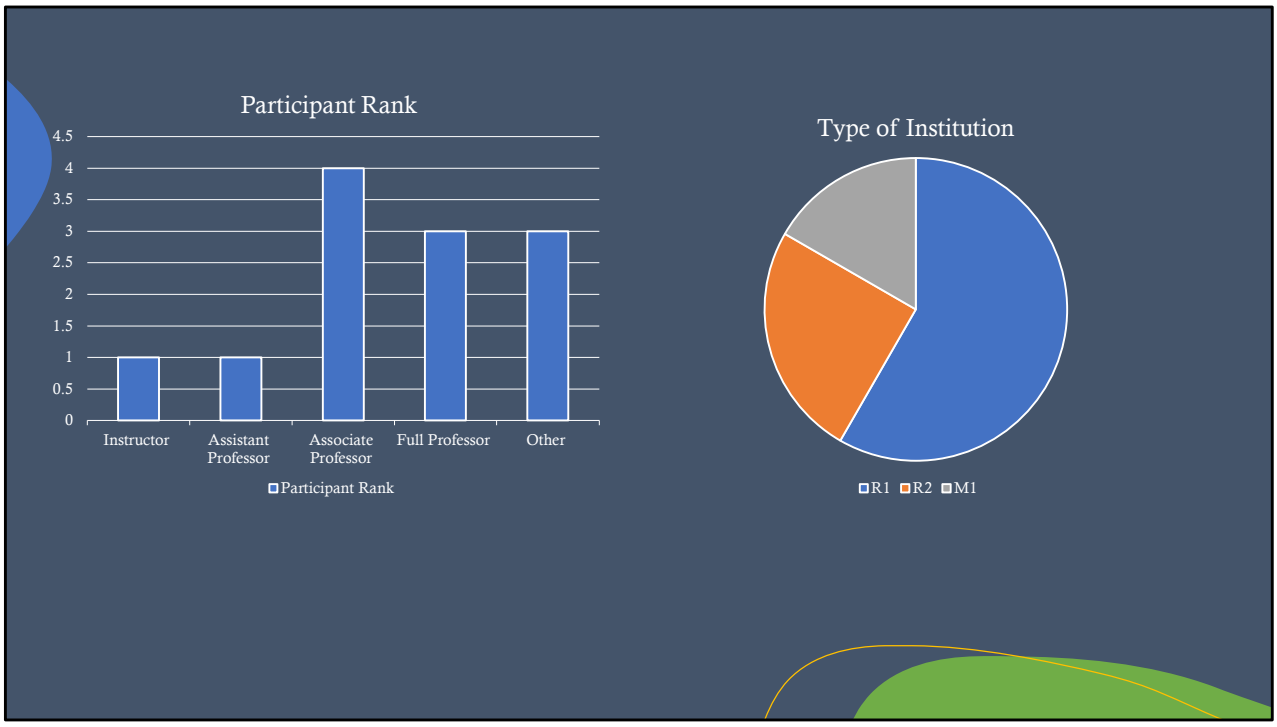
Is entrepreneurial mindset as defined by Davis et al., 2016 relevant to the success of FWoC in STEM disciplines of higher education?
Are there any differences in how women of color define and achieve success compared to the status quo?

Discuss positionality and reflexivity (see slide).
In terms of power dynamics, we felt that our shared experiences as faculty members allowed for more equity in discussions.
The act of reflection and positionality is important in qualitative research as they may influence the interpretation of findings as well as the research questions asked.



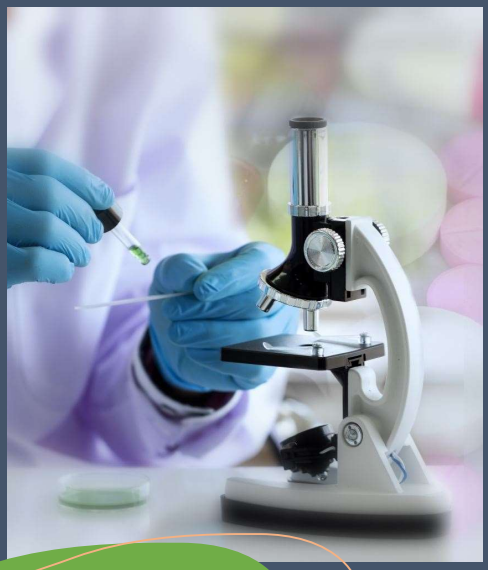
Phenomenology (interpretive) is concerned with how individuals make sense of their personal and professional experiences. Our interview questions addressed success, professional identity, stress, and support which are all deeply rooted in personal experiences and meanings.

Our sample include 12 FWoC who were predominantly Latina or African American. Note that participants could identify more than one racial/ethnic group.



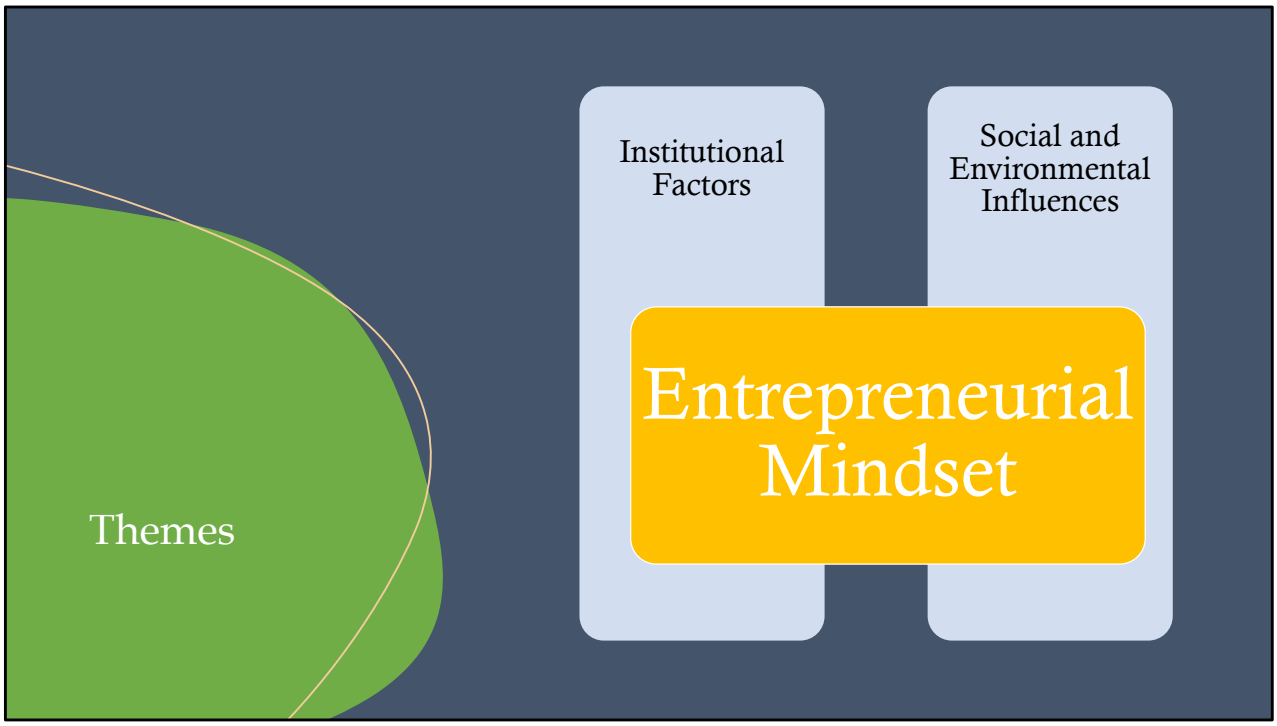
Other included: scholar in residence, 1 teaching assistant professor, 1 teaching associate professor

7 – Very High Research Activity (R1)
3 – High Research Activity (R2)
2 – Masters College & University (M1)



Fields reflected among sample

- Biochemistry
- Clinical Psychology
- Engineering (Chemical, Design, & Mechanical)
- Education (Engineering & Mathematics)
- Forensic Science
- Marine Biology
- Communication



We consider Entrepreneurial Mindset as a series of personal characteristics that are to varying degrees influenced by institutional factors and social and environmental experiences.

- Entrepreneurial Mindset has a variety of definitions making it challenging to conceptualize, however it is an important concept for success primarily used among engineering students.

- EM, encompassing motives, skills, and thought processes, (Davis et al., 2016) emerged as a cornerstone of FWoC's success. While traditional markers of academic success such as robust research and collaboration were noted, the ability to connect with students and experiences of discrimination/microaggression were equally highlighted.

Motives

So, in my so my university, we are teaching focused, but we still have a research agenda. **So, number one has been my ability to teach students successfully; to mentor them, to engage them in any type of activities that lead to learning whatever that might be. So that's the most important one at my institution**, there's also research. **I need to have an active research project**, whereas I don't need to have funding. I need to show that I am being active in seeking funding, **I have to be actively applying for grant proposals and it's in my field it's mostly NSF. I need to have publications in peer reviewed journals [and] presentations**. You know, all that stuff and then in service. All the etcetera like that that drawer at your home, where you just throw everything else. Everything else goes there. The junk drawer, that['s] service everything else. – *Mila, Latina, Puerto Rican*

- Motives – a psychological feature that arouses a person to action to meet a specific goal. In terms of EM, this can be framed as achievement orientation, impact, and value creation.

- Achievement orientation - A focus on setting and reaching goals, often driven by a desire for success, recognition, or personal fulfillment.

- Impact - A motive to make a significant impact on society, a market, or a specific community, often linked to a sense of purpose.

- Value Creation - A strong motivation to create products, services, or solutions that add value to others, whether through innovation, efficiency, or social impact.

- The underlined portion here can best be capture as the achievement orientation aspect of motives.

Hard skills

I for a long time, undervalued my contribution and did not really see the other side of the coin, which was a lot of [] academicians with PhDs have no idea what it's like to actually work in the field, which means in the real world, as an engineer with making actual products, and I have that. And so I never really try to bring that to light and actually value that part of me instead of focusing on what I don't have, I neglected what I do have and somehow I was able to make the transition, hey, I can connect with the students because they are gonna go into the field and I've been there and I actually know what it's like to work in the field producing a product, being out there, talking to technicians, other engineers and how it doesn't matter what kind of engineer we all need to work as a team. – *Rosa – Latina Mexican/Indigenous*

- Skills (primarily soft skills) – A special ability to do something well. This includes strategic thinking, problem solving, opportunity recognition, and resilience and adaptability.

- Skills – hard and soft skills with most findings covering a variety of soft skills
- Hard skills – Job related abilities and competencies that are learned and can be demonstrated in a measurable way.

- Note the other themes that emerge here: feeling inadequate that would fall under the thought processes section of EM.

Soft Skills

So, I think early on it was sort of push from mentors about what I could do… But I think in terms of an internal quality, I'm very organized and I persevere, and I can solve problems, and I got a lot of sticktoitiveness… I learned quickly about what works and what doesn't. *Naomi – Latina*

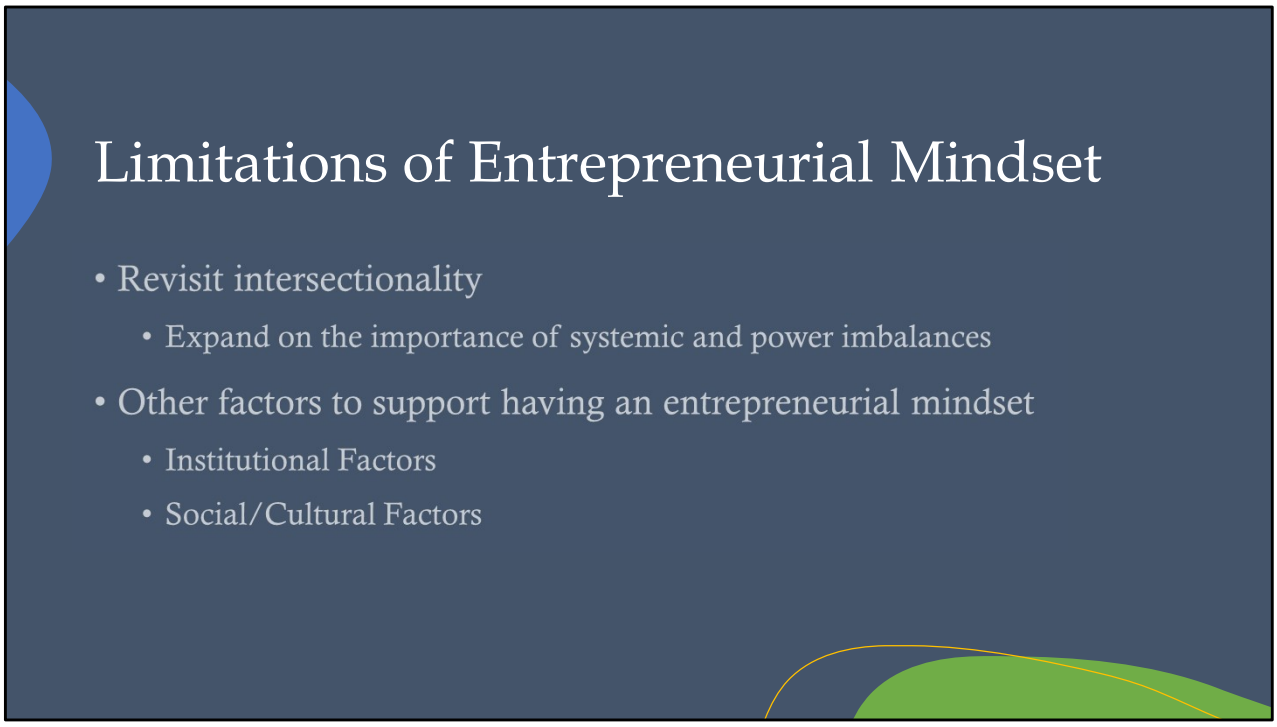
- There was significant variety in the soft skills presented from participants. They included
  - Opportunity recognition - The ability to identify and evaluate potential opportunities in the market or environment that others might overlook.
  - Problem Solving - A strong ability to analyze complex situations, identify challenges, and develop practical solutions. This is recognized in our participant quote.
  - Resilience and Adaptability - The skill to bounce back from setbacks, learn from failures, and adapt to changing circumstances.
  - Strategic Thinking - The ability to plan long-term, set goals, and align resources and actions to achieve them.

Thought processes

It's because I connect theory to practice. I'm not disillusioned in the sense that where persons write these nice papers, and it just reads and goes on the shelf, and no one cares. No, my technique is, I put it in the newspaper. In the papers, I talk about it. I do my speeches about it. I will go to the schools and work with those students in that space. It's theory to practice... I try to create things that teachers or people can appreciate because I think that's one of the limitations of higher ed. We get caught up in these little bubbles. When you die, your bubble stops because your body [is]obsolete and becomes dated and we now need a new version. Versus building a legacy as to, you're leaving a footprint where people remember not just the title of the name, the person. That's why I say, I'm unapologetically me. ~ *Lola, Black/African American*

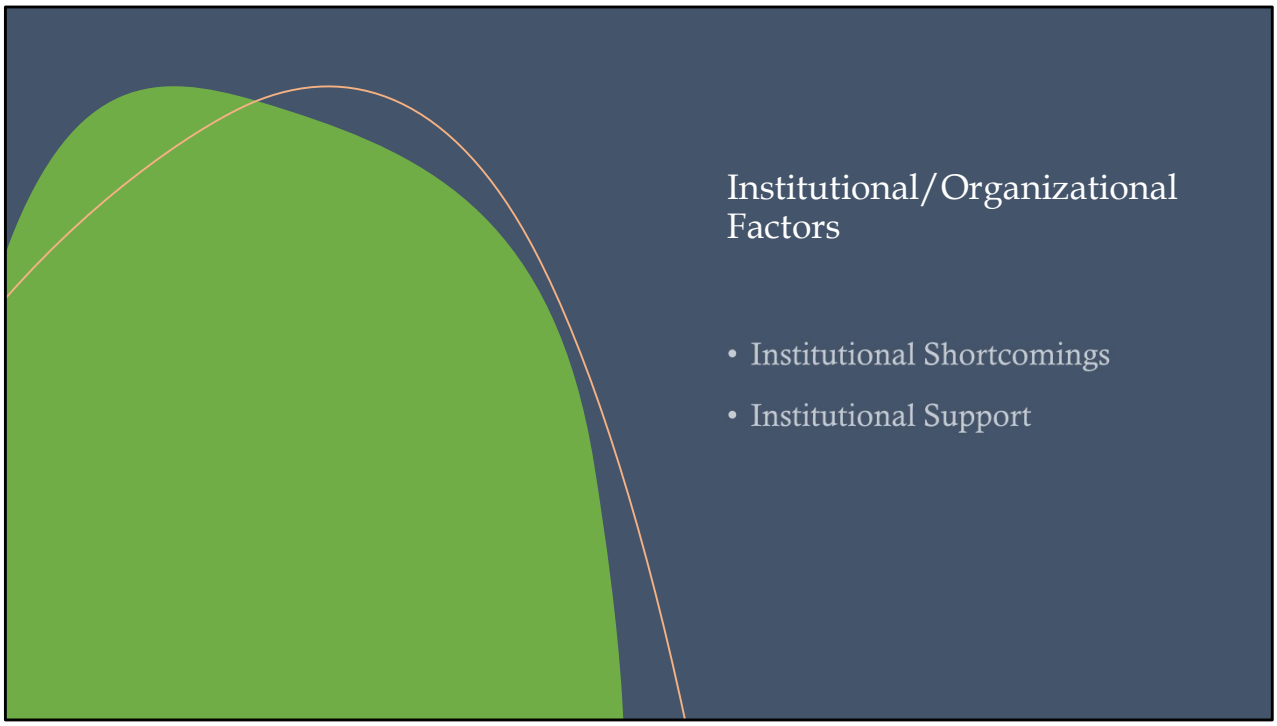
- Recall that EM is considered a cognitively based phenomena. Specifically, cognition – the way one thinks and metacognition – how one thinks about thinking.
- This includes growth mindset, resourcefulness, and ethical and social responsibility but in our sample, this also represented the negative thought processes experiences by participants such as stereotype threat and imposter syndrome that FWoC and others must navigate to be successful.

- Lola describes her approach to meeting the needs of the community and professionals she serves. This is a type of cognitive approach that is directly linked to human behavior. Less direct, is the association with social responsibility in the language that Lola uses primarily the term "legacy".



- Limitations of entrepreneurial or other personal factors. Overall failure to acknowledge systemic issues which with marginalized or underrepresented population plays a critical role in their success.

- If you recall, earlier in our presentation, we noted that women overall had lower rates of success in STEM fields and this was more pronounced among racial and ethnic minorities, wherein it was disproportionate to the representation in the population.



- Structural barriers within institutions pose formidable challenges to FWoC's success, ranging from issues of inclusion to the availability of mentorship.
- Despite the resilience and resourcefulness demonstrated by FWoC, these systemic impediments remain as significant obstacles.
- Definition: inclusive of all academic institutional systems that lead to a STEM career including early childhood exposure to the field unless occurring within a non-formal setting where it may be classified as social and environmental influences.
- Challenges included issues with inclusion & lack of institutional support typically at the career level.
- Institutional support – inclusive of receiving mentorship and exposure to field include past and current experiences.

Institutional Shortcomings

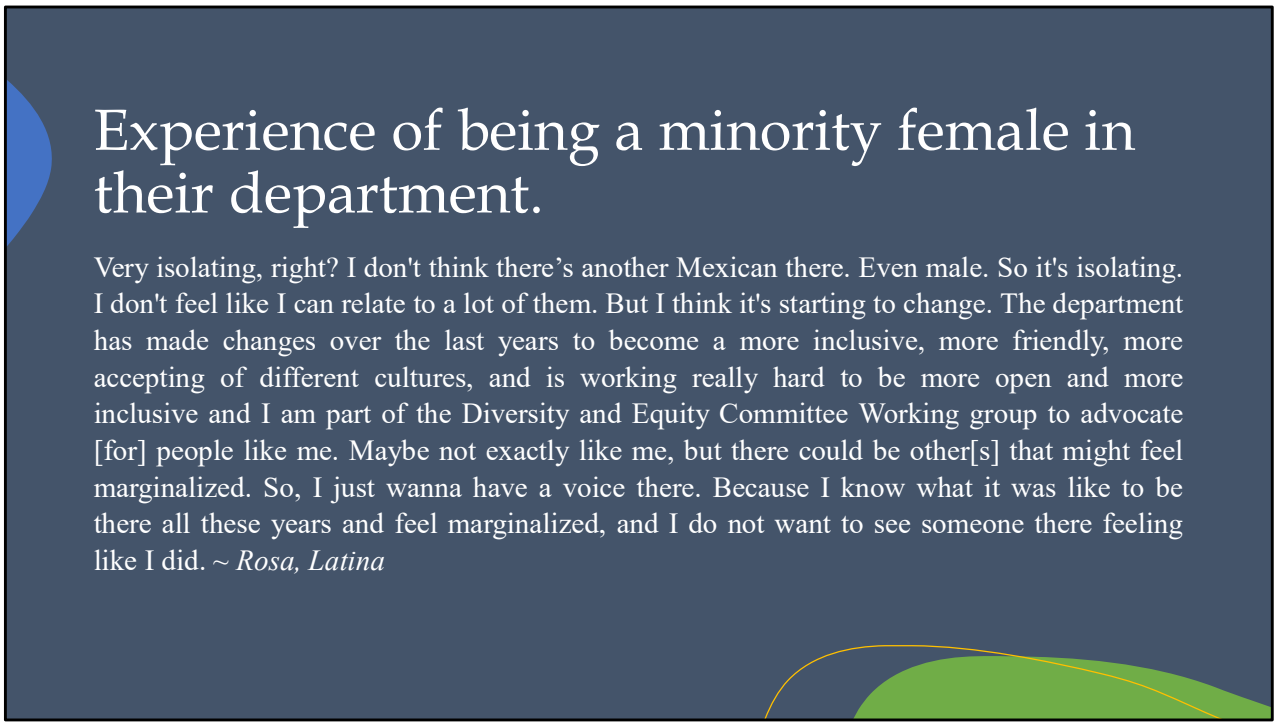
I decided through this process. And I say this process, I mean like graduate school, junior faculty, tenured. A lot of it was unnecessarily hard. I feel like there are a lot of **hidden curriculum in these spaces**. Lot of things that aren't talked about, things that you're supposed to know. I'm using air quotes, information and knowledge [you] are supposed to have coming into these spaces that the vast majority of people don't. But if they learn it **through mentors and champions in their role, people that take a liking to them and share the secret handbook** with them as they go, right? And so for me, that was dumb. And so part of what became sort of like my North Star is if there's ever an opportunity for me to take the veil off of the system or share the handbook. That's what I wanna do. – *Kim, African American*

- Commonly reported institutional shortcomings were (a) lack of representation and role models, (b) service and diversity workload, (c) lack of mentorship and sponsorship mechanisms, (d) work life imbalance, (e) poor or superficial institutional accountability to DEI.
- Our participant here speaks of a hidden curriculum that disadvantages some group's success in navigating STEM and academia. This falls under the subcategory of lack of mentorship and sponsorship mechanisms.
- We can also see here that our participant exemplifies problem solving skills related to EM and other relevant skills to navigate this issue.
- Additionally, please note the mention of mentors and champions, these individuals were commonly reported as critical to the success of our participants, including serving as gateway scientists to their area of study. However, many participants reported individual mentors that may or may not correspond with formal mentorship programs.

Experience of being a minority female in their department.

My experience of being Hispanic in the department that I'm sort of considered or I think of myself as being sort of the angry and loud woman in meetings and that that was my experience when I was in a leadership position within the department. I think a lot of my passion and the way I express myself was often interpreted in a certain way that that that was aversive to other people and some of that just came from how I've always expressed myself…It's taken me a long time even now to sort of know how to modulate that in a way …people can digest better, right. I still struggle with that quite a bit. And somehow that's a socialization process. - *Naomi, Latina*

- Ask participants to examine what they may notice here in this participant's report.
- Should this be considered personal or institutional?
- STEM/higher education is defined with the Anglo-American concept of communication wish is in contrast with the way in which Latin/Hispanic and other more expressive populations may communicate which may be represented through higher volume, faster speech, more hand movement, and increased touch (haptics), and closer proximity in interactions (proxemics). This presents an institutional failure to be culturally responsive.
- How might this relate to EM thought processes? Is there a level of internalized discrimination in participant's language choice.

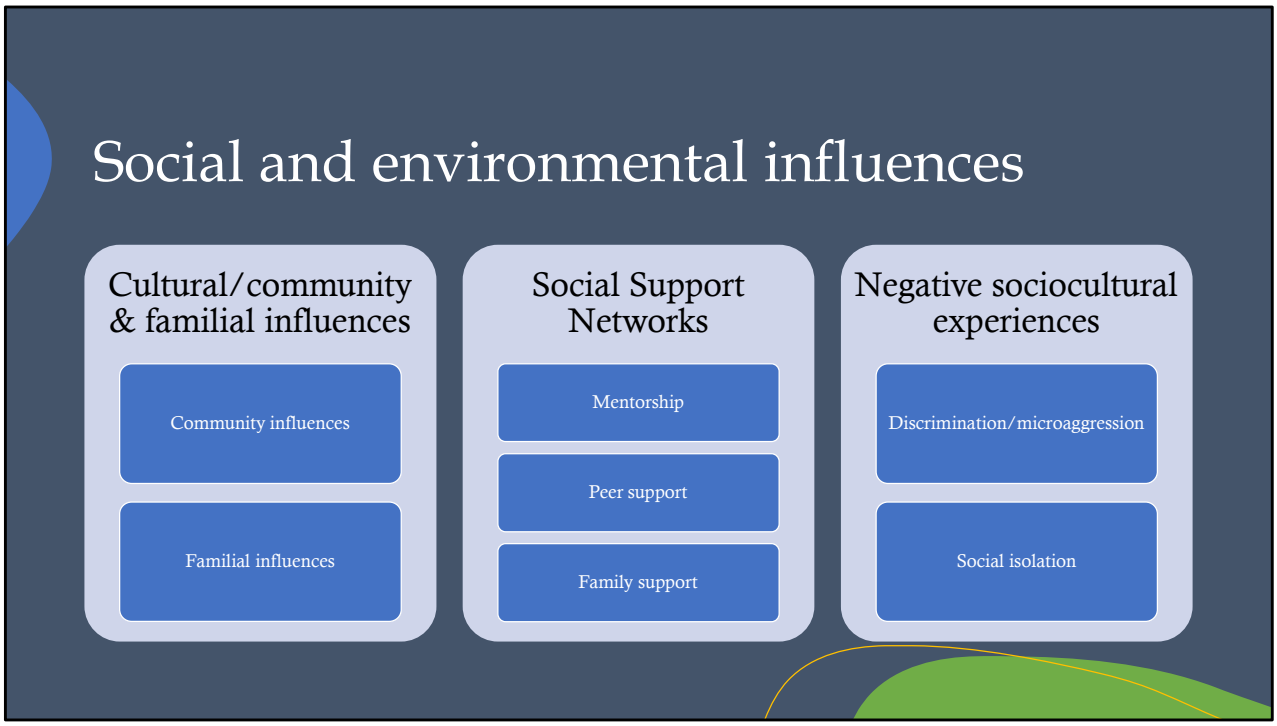


Common among participants was the experience of being the only female, person of color in their department or one of a few. They often characterized the experience as isolating. As described by Rosa, many participants felt it important to support systemic change or to develop a network/support system to better navigate the isolation. This often resulted in increased service load among FWoC which may have adverse impacts on their research productivity.

Institutional Support

I have a wonderful department chair. Wonderful. I have had good department chairs and [] all of them have been mindful of my family construct. When I started graduate school, my daughters were maybe 4-5, 5-6 somewhere in there. They're maybe a little bit older and they've all- the people in my department have all known that my family comes first. And so, whenever we had activities for the department, if you saw me, you saw my daughters and my husband, we do everything. As for the most part, we do most things as a team, especially my daughters and I, so they, whenever I needed to take off for something, which has been very few times, I've gotten permission. I have to in a few weeks, take my daughter to school. And it just so happens that when I drop her off the next day, she begins school. I can't be back home on our first day of school. So, I've talked to my department chair, and she said, of course you can Zoom or you can just be absent that day. So, I get that support. That's invaluable. – *Jasmine, African American*

- Examples of institutional supports captured in our data were (a) mentorship and sponsorship programs, (b) supportive family/work policies, (c) Access to other resources and opportunities, (d) institutional transparency.
- Here, our participant captures the value of leadership support in the form of a dean and how the department recognizes their commitment to family. This falls under the subcategory of supportive family/work policies.
- Throughout our interviews, many participants discussed navigating the work-life balance and having to re-examine priorities as they advance through their careers with the most challenge occurring earlier in their careers.

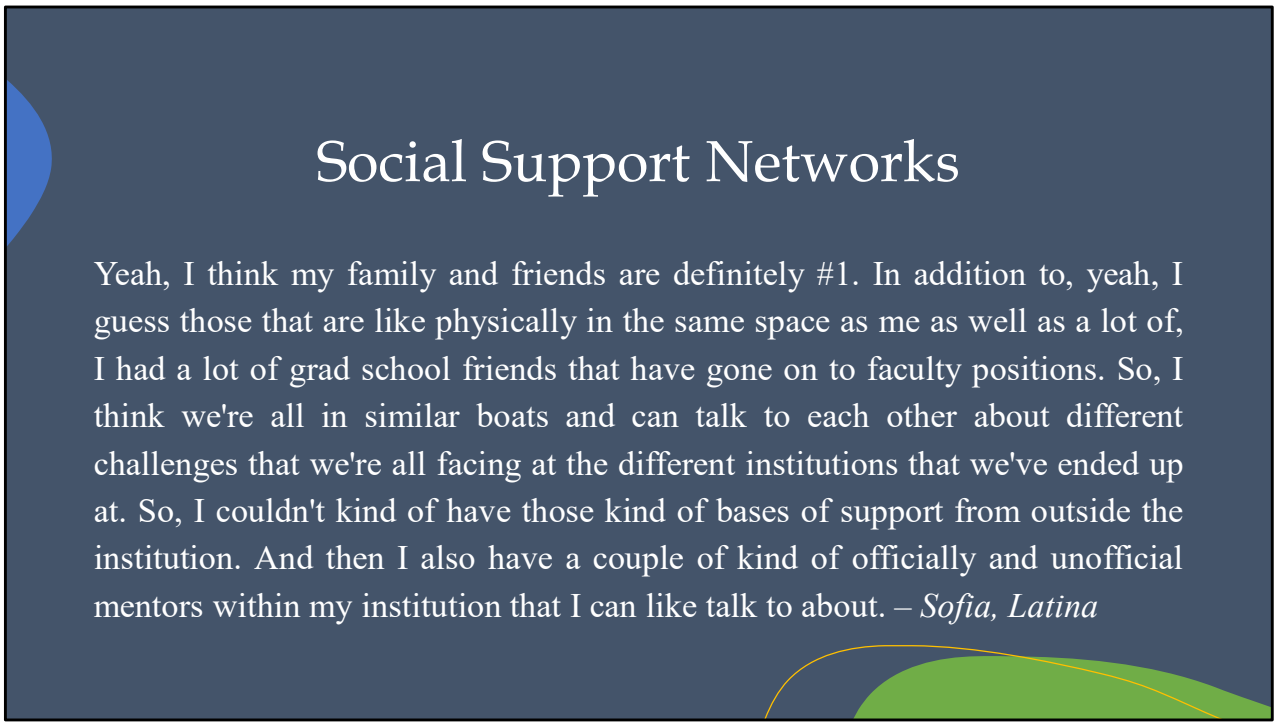


- Recall that these factors MAY have the ability to shape entrepreneurial mindset including their influence on shaping thought processes and contributing to the developing of survival soft skills.

- Here we see three broad categories of social and environmental influences. [Read slide]

- Note that we make a distinction between family influences and support. Family influence captures the influence of professionals within the family on the participant's career prospects and expectations while family support includes any kind of tangible or intangible support provided by family members, not simply exposure to a career field or visibility.

- Social and environmental influences on success were deeply intertwined with participants' experiences, underscoring the influence of cultural backgrounds and familial support on their academic journeys.
- Something as simple as playing with Legos allowed this participant to explore their scientific curiosity. These kinds of experiences were common among participants wherein they had family members/relatives who studied the sciences or parents/caregivers who encouraged their academic advancement and exploration



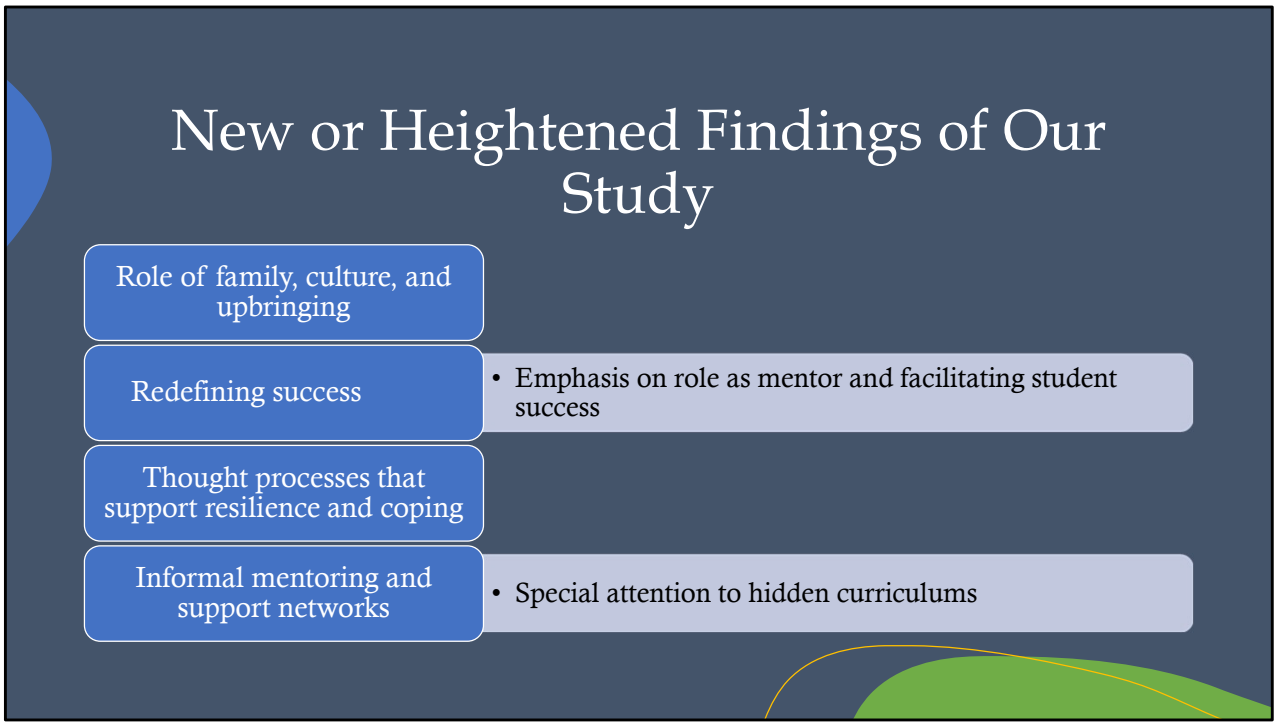
Here we see several members of Sofia's support system include family and friends, but also grad school friends and mentors that round out the support system. Sofia's quote would fall under a few subcategories related to social support networks including family and peers.

Another example…

I think role models and peers that have built me up and I guess even from my growing up, I had two working parents. **My mom I think was a very good role model for me…A Hispanic female that was able to achieve success, not in an academic setting, but in an entrepreneurial setting** and was very much the power dynamic like between my like parents…**It was like normal for me to see, a woman of color, achieve, go for these like high goals and achieve success in her career while also having a family and keeping that as an important part of her life as well.** So, I think that was very instrumental for me growing up. And I think even though she's not in the academic field, I think just because of seeing her example and then her helping me make connections, even though she's in a slightly different field…**I think in grad school, there were definitely challenges. I would have went through many phases of imposter syndrome and thinking that I was not good enough to succeed in research or in the PhD, but I had a lot of role models and peers.** So, the research groups that I ended up being joining in mechanical engineering were my primary advisor was the female of color and a lot of the lab members. I think we were probably 60 to 70% female and there was a decent amount of diversity. So, I think having the community at least, within my lab group, even though that was not necessarily like the community that was dominant in mechanical engineering, for example, I think was definitely helpful.—*Sofia, Latina*

- Here we see the role of early exposure to the field in shaping interest and foster positive attitudes towards STEM
- Experiences of imposter syndrome and the importance of representation in mentorship/and social support

These are examples of challenges and supports to success reported in other studies including but not limited to findings from Alfred et al., 2019; Cooper & Stevens, 2002, Domingo et al., 2022; Ong et al., 2011; Schneider et al., 2024, Turner et al., 2008; Williams et al., 2016; Wright et al., 2023.



Here we highlight findings we found to either be new or particularly heightened in our sample.

1. The role of family, culture, and upbringing has often remained unexplored. Many FWoC are from collectivist cultures where the influence of family and community is critical in development. In our sample, participants often reported on how crucial the influence and support of members of the community and family was in shaping their career interests and self-efficacy in achieving a career in STEM.
2. Redefining success was an important aspect of the counter narrative about motivations for academic and professional pursuits. While participants did report recognition, personal fulfillment, and a desire for success as motives toward their academic and professional pursuits, they also reported the need to have an impact on emerging FWoC and other minority populations entering STEM fields, a need to create value specifically around having a social impact either within or outside their current institution. Often the social impact was housed in the context of changing the experiencing of minority students who were navigating STEM and creating a more inclusive and welcoming workspace.
3. Our findings showed an emphasis on the cognitive aspects of entrepreneurial mindset which was especially critical for participants who had experiences of discrimination and microaggressions but felt it necessary to persevere in the hopes of changing the experiences for the next set of minority scholars.

4. Finally, while many students have shown the importance of formal mentorship programs, and we agree that this is critical for systemic change, many participants reported having to form informal mentoring and support networks. While informal mentoring is not new, the need for seeking out and creating their own social network within and outside of their institution proved to be especially useful in navigating what participants described as a hidden curriculum.

Discussion & Questions

Open for questions

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