2021 ASEE ANNUAL CONFERENCE
Virtual Meeting | July 26–29, 2021 | Pacific Daylight Time
Paper ID #34854

Race, Gender and Persistence in Engineering and Computing: A Qualitative Analysis of Female Student Experiences at a Minority Serving Institution (MSI)

Mrs. Diane Nicole Abdullah, Florida International University
Dr. Trina L. Fletcher, Florida International University

Dr. Fletcher is currently an Assistant Professor at Florida International University. Her research focus equity and inclusion within STEM education, STEM at HBCUs and K-12 STEM education. Prior to FIU, Dr. Fletcher served as the Director of Pre-college Programs for the National Society of Black Engineers (NSBE). Additionally, she spent time in industry holding technical and operations-based roles and has experience with outreach projects focused on STEM education and mentoring.

Ronald Quintero, Florida International University
Jade R. Moten, Florida International University

Jade R. Moten is a graduate student at Florida International University in Miami, Florida. Her research interests include expanding diversity, equity, and inclusion practices in engineering education, policy development, TRIO programs, and quality tool implementation.

Miss Brittany Nicole Boyd, Morgan State University

Brittany N. Boyd is currently a doctoral student at Morgan State University. Her research interests include scale development to examine post-secondary experiences and program evaluation for supplemental programs, with a focus on the impact of intervention programs and other support systems on the retention of underrepresented students.

Race, Gender and Persistence in Engineering and Computing: A Qualitative Analysis of Female Student Experiences at a Minority Serving Institution (MSI)

Abstract— **Within engineering and computer science programs at a southeast-based minority serving institution (MSI), efforts have been made to help improve the participation in and success of female students within the fields. This has been done by partnering with external organizations and implementing programming to address documented reasons for lower female participation in engineering and computing. Using a critical race theory (CRT) lens and intersectionality conceptual framework, this research study consisted of conducting individual interviews with current undergraduate female students within engineering and computing. The interviews were coded, analyzed and thoroughly documented within the results and discussion session. Findings show that experiences prior to entering college, family involvement, social group involvement and institutional culture and climate all play critical roles in female student persistence through these academic programs. The dissemination of these results will contribute towards identifying opportunities in which to remove barriers for women within the engineering and computing discipline by understanding their experiences and participation in the fields.**

I. Introduction

Recent reports from the National Science Foundation (NSF) have indicated that while the number of women in Science and Engineering (S&E) related jobs continue to grow, the group remains underrepresented in the S&E workforce relative to their overall presence in the population [1]. The lack of women in STEM transcends traditional narratives on the importance of broadening participation and increasing STEM diversity because of the nuanced issues women face in a male dominated field. Issues concerning women feeling unwelcomed in STEM begin at the academic level and researchers have determined that several factors affect a woman's recruitment and retention in STEM-related majors. Support entities such as family, peers, and big sister programs are all common themes among positive influences for women in STEM fields. On the other hand, isolation, stereotypes, and discrimination all hinder a women's acceptance within her STEM environment [2].

College programs must reach out to marginalized populations to increase their interest in seeking STEM degrees, especially within the areas of engineering and computer science, so that we collectively meet domestic and global workforce demands. Additionally, to satisfy these demands, increased focus on retaining more women into these fields has taken priority with many colleges, including programs and initiatives linked to developing the aforementioned social support groups. However, women continue to hold a disproportionately low share of STEM undergraduate degrees, particularly in engineering and computing, despite growing efforts to encourage women to pursue careers in STEM. For example, women comprise 46% of the available workforce [3] yet they make up less than 20% of bachelor's degrees awarded in computer science and only 22% awarded in engineering [4]. These findings highlight the need to further examine the dynamics linked to women in engineering and computer science. To understand the need to increase enrollment of women in STEM programs, this study will examine qualitative data in the form of interviews collected from female students within the college of engineering and computing (CEC) at a research-intensive (R1) public minority-serving institution (MSI). A review of the literature revealed several studies that expressed challenges experienced by females in engineering and computing, especially for those of diverse backgrounds. Additionally, studies reviewed showed that experiences varied by different types of engineering and computing fields.

II. LITERATURE REVIEW

The majority of students who withdraw from STEM are underrepresented Students of Color[5]. There have been several studies to better understand the unique experience of Women of Color in Engineering and Computing. Additionally, these studies have critically highlighted the contributing factor of persistence that these female students demonstrate within their academic careers, as well as what challenges that same persistence. A couple of frameworks were considered when analyzing these challenges and how they related to our data and future works. We began from the Critical Race Theory (CRT) as a foundation for analysis. CRT explains the inherent racialized hierarchy in the United States with regards to how and who institutionalized systems provide access and resources. It conveys that the primary beneficiaries of the social and financial structure of the United States., have been the rooted in the construct of White Maleness and proximal identities. Through a CRT lens, one can ascertain that communities of color must gain some sort of cultural wealth to supply social mobility [6]. Community Cultural Wealth (CCW) "acknowledges the cultural wealth that stems from the lived experiences of marginalized students" [2]. Yosso [6] classifies community cultural wealth into six categories: aspirational, linguistic, familial, social, navigational and resistant capital [6]. In addition, one must also consider a lens of intersectionality. That is, how women can experience multiple oppressions due to the intersection of their identity not only as women but also as women of color, before even mentioning other contributing identities they inhabit. To complete our analysis, we also examined the Social Cognitive Career Theory (SCCT), which posits that self-efficacy, expected outcomes and goal mechanisms are strongly related to career development [7].

The persistence of women in STEM can be attributed to many factors. However, one of the factors that remain key is Azizova and Felder's concept of[8] "an intrinsic foundation", which can be broken down into qualities such as: exceptionality, confidence, potential for self-actualization and professional self-worth. In terms of Community Cultural Wealth, this would be considered "aspirational capital" which is defined as the ability to continue to hold hope for the future, despite any perceived or real challenges [6]. This culmination of sources contributes to the self-efficacy Lent and his colleagues [7], [9] highlighted within the SCCT framework. This confidence and innate sense of certainty that an individual is capable can have a great influence on students and their desire to persevere. It is with this internal drive that underrepresented women of color in STEM fields are able to succeed. Therefore, the women who persist in the STEM field have great aspirational capital, which can indeed be asserted by their community. In their findings, Azizova and Felder [8] suggests [that] "Given its positive driving power, the sense of exceptionality tied to the sense of confidence and vision of self-actualization and professional self-worth should be fostered and cultivated by graduate faculty and administrators". The encouragement from leaders and mentors in the engineering community can have a tremendous impact on students by creating a sense of belonging.

In Alonso's [10] study, the influence of a Society of Hispanic Professional Engineers (SHPE) membership on the engineering identity of Latinx students was investigated. Alonso concluded that SHPE "...served as an academic, social, and professional counter-space for students, which was key in their engineering identity development." SHPE has been very successful in creating and nurturing a community for Hispanic engineers, which increases students' familial capital (having a sense of community) and social capital (knowing how to network and use community

resources). Some of the prevailing themes from her study were: developing professional and leadership skills, making an impact in the community, being a role model to current and prospective engineering students, finding engineering role models and nurturing an engineering 'familia'. Not only has SHPE allowed Latinx students to feel a sense of belonging and family, but they have provided them with a network. Through these connections, students are able to thrive and help others to do the same. Being able to succeed and help others in their same community succeed only strengthens students' navigational capital - their ability to navigate through social institutions not necessarily designed for communities of color [6]. These experiences and relationships provide the environment to cultivate a feedback loop for performance attainments which contribute to the individual's engineering identity.

In "Understanding the Experiences of Women of Color in Engineering", Alonso [11] studied how engineering identities intersect with other identities. This study brings another element to the framework of Intersectionality - the individual's perception and a peer's perception of them being identified as an engineer. To clarify, we are not only observing if the individual identifies as an engineer but how that reflection compares to them feeling they are being portrayed as an engineer within their community. It is a matter of discerning which factors contribute to these identities and which factors dissociate the student with that identity. Through our study, it was apparent that this identity could be solidified by being established prior to attending college. Rincon [5] states [that] "...expressing early interest in STEM fields is related to future math and science course-taking patterns in high school, enrolling in a STEM major, and persisting to a degree". If identities can be strengthened by early exposure to STEM, we can conclude that the same applies to the exposure of an engineering community. Furthermore, Cadenas and colleagues [12] discuss how it may be possible that non-marginalized groups might develop career self-efficacy and outcome expectations more carefully in comparison to marginalized groups. This may be attributed to their lack of exposure to outcome expectations which in turn would not necessitate self-efficacy.

III. THEORETICAL FRAMEWORK

A. Critical Race Theory

The Critical Race Theory examines the role of race within all aspects American society and institutions, including educational experiences [14]. By examining the impacts of racialized society on educational outcomes and disparities, CRT offers a framework to understanding overt and covert manifestations of inequity through interrogating the values, policies, and results of the institution of note. Within education policy and structures, race-based solutions must be present to expand counternarratives and center equity. Intersectionality and Social Cognitive Career theory are applied with the context of CRT to unpack the experiences ofWomen in a College of Engineering and Computing at a southeast based minority serving institution.

B. Intersectionality

Further research on sociological impacts and factors on women arose the need to include the theory of intersectionality as a contributing conceptual framework to continue evaluating the observations of this study. The theory of intersectionality was coined in 1989 by legal scholar Kimberle Crenshaw [13], who used the concept to describe how personal characteristics like race, class,

wealth, and gender all ‘intersect’ with one another. For example, when observing the experiences of Black women, Crenshaw argued that a researcher must consider the overlapping effect of being both Black and a woman[13]. While concepts of intersectionality have been widely established across fields of social sciences, intersectionality is seldom considered in STEM education studies of marginalized groups[14]. This framework allows for the observation of both the material and structural constraints that significantly shape a woman's sense of possibility and opportunities[15]. Intersectionality also continues to become a topic of interest when discussing WOC in engineering and their success or departure from the field, beginning in primary educational institutions and continuing through the work force.

C. Community Cultural Wealth

Leaning on a framework designed to highlight the unique skillsets and talents that Students of Color contribute—with context to Women of Engineering and Computing; Yosso’s Community Cultural Wealth (CCW) Model offers an approach that highlights the underestimated strengths in with consideration of traditionally held, often exclusionary, university values[16]. Yosso maintained that “all for forms of capital can be used to empower individuals,” hence the model that demonstrates Students of Color’s strengths. The six primary forms of CCW model encompasses the following: 1.) the Hopes and Dreams/ or aspirational capital, 2.) language skills that the student arrives with including storytelling, 3.)the interpersonal communication that enhances their rhetoric skills, 4.) and communal support offered by their lived-sociocultural experiences 5.) as well as, methods of navigating unfriendly—sometimes hostile spaces, 6.) using the prior as leverage to inform and navigate in academic spaces to ultimately manifest as resistance. CCW supports and furthers the CRT knowledge base whilst centering a counter-narrative of a strengths-based valuation of offered skills and attributes that Students of Color hold. The use of CCW bucks the historical happenings that tend to devalue Students of Color experiences and perspectives. MSIs seek to offer a supportive environment that gives students permission to be who they are outside of racial and cultural lines; this is seen within this paper.

D. Social Cognitive Career Theory

Social Cognitive Career Theory (SCCT) explains three correlative aspects of career development: the evolution of academic and career interests, how students choose educational and career choices, and how academic career success/persistence is obtained [7], [9]. For the purposes of our specific study, we chose to focus on three contributing factors SCCT accredit to career development: self-efficacy beliefs, outcome expectations, and goals. Self-efficacy beliefs are an individual’s personal belief about their capability to perform certain tasks. These beliefs can be created by their own experiences of how well they perform. For women particularly, recognition from others (regarding their performance) is one of their main sources of self-efficacy [17]. This suggests that individuals actively respond to the environment as opposed to being passive recipients [18]. When individuals have strong self-efficacy beliefs about a certain activity, they will in turn, perform better, be more interested and ultimately, choose to pursue goals associated with those activities. Self-efficacy can be sustained when rewarded with positive outcomes as individuals will continue to pursue these activities by setting goals to further their successes. This solidifies their interests and contributes to goal persistence [18]. Correspondingly, self-efficacy leads to outcome expectations which lead to goal mechanisms, creating a linear pathway and explanation for career success.

IV. Research Questions

Based on the literature, the following two (2) research questions were determined for this qualitative study:

(1) What are the general experiences of underrepresented Hispanic female students studying engineering and computing at a Minority Serving Institution (MSI)?

(2) What contributes to the persistence of women in engineering and computing at a Hispanic Serving Institution (HSI)?

V. Methodology

An institutional review board (IRB) was submitted and approved for this research to be conducted. The data analyzed in this report is based on six interviews that were administered through the Summer of 2020. A workshop focused on female empowerment at the College of Engineering compiled a list of attendee information such as names and e-mail addresses, which became our primary source of participants. E-mails were sent out to scout for potential interviewees and responders were then selected at random to participate in the study.

The cohort of six interviewees ranged from juniors to seniors and the majors consisted of three mechanical engineering, one interdisciplinary engineering, one biomedical engineering, and one computer science. All but one student interviewed attended an engineering-specific campus located away from the main university campus. Interview participants provided subjective and first-person responses according to their experiences as female students to answer our questions. Probes were elicited to obtain richer context and/or more consistent data. All interviews were scheduled and done through Zoom, a virtual meeting application, with both the interviewer and interviewee maintaining face-to-face visibility using webcams. Interviews ranged from 20 to 60 minutes.

Team-based coding was implemented to maintain consistency and promote project management. A total of three researchers were assigned to two interviews each. Researchers coded interviews manually and then came together to share and discuss similar and contrasting themes that emerged from the coding. Finally, aliases are used below for each participant when presenting their responses as to mask their identity and preserve anonymity.

VI. Results and Discussion

Upon completion of the analysis, four different themes emerged from the interviews with each student. Each student displayed a strong engineering identity, possessed self-efficacy, relied on support entities and felt that their experience was unique. Despite students having different interests and majors, their experience and narrative still drew many parallels. It was evident that these students' persistence could be attributed to these four factors and their interrelation.

A. Interest, motivation, and self-efficacy

While each student faced their own challenges, it was evident that all of them had an "intrinsic foundation" which allowed them to persevere. One of the commonalities between the interviewed students was realizing that their own interest and motivation was greater than their struggles and/or what others were suggesting of their abilities. Their self-efficacy was a recurring theme with most of them having very similar anecdotes to Thelma's:

> *"I definitely think that I've always kind of been defined by academic success. It's always kind of been like – it's always been my thing; you know how everyone in the family always has their thing? Studies and like getting good grades and just being like very disciplined has always been mine in the family. So, I feel like just completing the goals, all the goals and ambitions that I have, really define me and like they definitely give me motivation and a lot of gratification.*

Olivia, the first student in her university to study under the Interdisciplinary Engineering major, discusses how she was motivated to pursue her career while in high school:

> *"I think my aspirations of wanting to go into engineering stem from the fact that this teacher kind of made it seem (and being in this school) that engineering is the way to go and there is no other way to go other than being in engineering. And then there were definitely a lot of times where let's say I didn't do too good on an exam or do too good on this, this was the type of teacher who would be like 'uh okay well then maybe this is not a field suited for you, maybe you should consider something else' and then those comments like that it almost is like 'Well, I don't appreciate that this teacher is saying things like this so maybe I want to go ..and prove her wrong.'"*

Paulina had a similar experience when explaining why she chose to persist in her career. She states:

> *"I had a talk with someone, and they told me 'But I don't know why you decided to get into such a tough major' and the fact that they had asked me - that almost felt like an insult like 'so are you saying you don't think I could do tough things?' And I just took it the other way and I was like 'I can handle this, I've got this.'*

When discussing possible career paths for her major, Abby demonstrates a great ambition and desire to not only succeed, but to outperform, which was also common between all students interviewed:

> *"It's a starting point for a lot of engineers to start off not in their dream job but I think that I aspire to do more than my peers."*

Similarly, when discussing how she decided to enroll for her major, Mulan states:

> *"Biomedical engineering was not even in the curriculum of the universities back home so I started by liking design, architecture and business administration but I thought I could do more."*

B. Engineering Identity

One of the factors that seem to have supported these female students in their strong sense of self-efficacy and ambition is the fact that most were introduced the STEM related topics in high school and all of them showed interests in math and science during high school. Consequently, four out of six of the students self-identified as an engineer and all of them felt identified by someone else as an engineer. As to her confidence in the engineering field, Thelma discussed her sense of pride in her major:

> *"I see myself as like a scientist in a way. I like being able to go to my internship every day and having new things presented to me and having to find you know, a way to solve these issues, without you know, anyone just spilling to me the answers. I feel very privileged in the sense to have this type of opportunity and like this chance to just demonstrate my intelligence. I feel very confident, like proud of being able to have this problem solving, and creativity and critical thinking skills that I'm not sure, well I can't speak for other majors, but I'm very happy that like my major encompasses these things."*

Thelma relates to her career; she has a deep connection to her field and its clearly demonstrated in her words. Daniella spoke about the positive feedback she received, which is the feedback loop necessary to continue in one's career path, as supported by the concepts of SCCT:

> *"I do [see myself as an engineer] and I think if I didn't, I probably wouldn't continue to pursue the career. So Yes, I do see myself as an engineer… With the Society of Hispanic Professional Engineers (SHPE), I feel very confident in that club … but then, with Eco-Engineering Club, I do doubt myself a little bit sometimes since first, I'm the only female in the group, that is actively involved … but I do feel like in the industry, for example, with my work experience at school and with the internship I had last summer and with the internship I have now, I do think people see me as an engineer. Especially since I've received very positive feedback from my managers and from my team members and I think that has really helped me in that sense of getting that self-confidence and that I can do it.*

In terms of intersectionality, Abby had a positive outlook in what it meant for her to be a woman in STEM. Despite being a minority in her field, she feels proud and purposeful because of that. She stated:

> *"As a woman, I feel kind of like empowered and inspired kind of knowing that we are a minority in STEM. Being able to really represent being a woman, I don't know, I think it's something that I admire that I can be a part of that and kind of improve the culture and the statistics."*

This implies that her engineering identity is cemented by her pride and sense of obligation to represent women in her field.

C. Support Entities

Another one of the commonalities between the female students were the importance of support entities in their lives. While four out of the six students had direct family members who were

engineers, all six students felt that their successes were attributed to their mentors, family and friends. The sense of community and belonging is what supported these students to persist.

Mulan shared how having sibling competition supported her in studying engineering. She stated:

> *"If I'm honest, I was not the best at Math or Physics, but they were my favorite courses cause they were really challenging courses. I have a twin brother; we were very competitive with each other during high school so that's what kept me going cause we would challenge each other to see who would get better grades. That's one factor that led me to study engineering as well because I like to be challenged and I know engineering is very challenging."*

Abby also gave credit to her support system for her successes:

> *"For me, what has allowed me to be successful I think is hard work ethic, perseverance, I've had plenty of good mentors that have walked this journey before me so having them only a phone call away to ask advice; I think a good community has also helped me be successful--being able to rely on friends and family to help I guess go through any hard times along the path."*

Similarly, Daniella shared her experiences with friends and how creating a support system through SHPE really encouraged and helped her persist in her career path:

> *"It became 'hey I like this. I love this. I have friends…I've become really good friends with people within the clubs that I am in' and that I think really kept me there and has kept me here for a while …We became friends and I think it went from being friends to being peers in the clubs but the experiences have been great, I've been able to develop personal and also professional experiences with most of my friends, I would say all of my friends in both clubs because we have found ways of learning from each other and we like to help each other learn ... We focus on hey we're interested in being engineers, we're interested in showing our community – I mean through SHPE, we love to do STEM outreach events so finding that group of people that are like me and that we are all looking towards the same things is really really cool."*

D. Feel Unique in their Experience

While all female students worked hard to obtain their internships opportunities and accomplish their goals, they all collectively felt like they had been exposed to certain resources that may have not been accessible to other students. Abby mentioned how she felt she had been fortunate in getting involved in research labs early on:

> *"I'm definitely blessed…the moment I stepped on campus, I got involved with research labs so I work … as an undergraduate research assistant…I've been there for two years now and that opportunity has really allowed me to grow as an engineer I would say and has essentially built my resume to be marketable when going to conferences. So, when I do go to conferences, I am very confident and proud of the work that I've done."*

In a parallel experience, Thelma describes how she has had a positive experience but knows that that is not the same for everyone:

> *"For example, like I've done research since I was a freshman… so it definitely put me in a position where I was very involved very quickly. However, having talked to different people and having different friends, not everyone is as not shy and outspoken in order to get those opportunities. So personally, I feel confident and happy with my experience but I think that comes with the personality that I have of you know, being very ambitious and willing to talk to people to get the most out of everything but I've noticed that a lot of people in [the university]- they're usually people that go to school, take their classes and leave versus I'm more 'okay let me take my classes and stay and like get to know different people' and I think that resulted in me being very involved with different things, which made me in a position to be confident because I know like I have a lot of friends that they're graduating soon and they don't have any engineering experience under their belt, like no internships, nothing cause it's a commute school...so you're usually just going from your classes to your house and I think that just hinders people without thinking it will in the future. Personally, I'm happy, I just wish I could see that same confidence in other people.*

When asked what she felt was missing to help students be successful, Daniella responded that she felt the university should promote their resources better and to all students:

> *"There are different reasons that I could say [University Organization] is not helping us be successful but I guess the spread of knowledge that you can start in industry early and the promotion of that knowledge throughout not only in the Engineering Campus but also Main Campus… you're like already getting a head start and that sense of promotion for working in industry, that is something that could help students be more successful because a lot of people feel like they can't find anything or that they can't look for opportunities when there is really a lot of resources but they're just not aware of them… I mean like conferences or events where they can go learn and be like 'okay, I can get a job by doing this' cause it's not as easy for everyone, especially if people haven't had an experience with finding a job first."*

Given that Daniella has had the experience of several internships, her statement implies that she has had a unique experience in comparison to her peers. Similarly, when Olivia shared about her experience with Imposter Syndrome, she also shared how she was not different from her peers but had just been given an opportunity:

> *"It felt like people would see [me] when I got back to campus, a bit differently; like this was the girl who had the opportunity to go to MIT and work on a project and I remember coming back that summer and I was like 'I don't want people to think that I'm some genius' because a lot of people would throw that terminology around. It kind of made me feel a little bit uncomfortable, it's like 'I'm no genius, I just kind of got there cause I applied there and they accepted me.' There are definitely times when I'm just like 'I'm just another person who got accepted into this program. I'm no genius. I'm not a better engineer than you are because I got into this program.'"*

CONCEPTUAL DISCUSSIONS

A. HSI'S HELP TO ALLEVIATE SOCIAL PAINS WITHIN HISPANIC STUDENTS:

Prior research referenced previously in this study has indicated that female minority students are more likely to suffer social pains in the engineering field. Intersectionality further states that an individual's race, gender, class and other nodes of identity all combine to create different modes of discrimination. However, while interviewees claimed to have faced some form of discrimination due to their gender, none claimed to have faced difficulty due to their race while attending the university. One of the social pains described in Ong et al.'s [2] social literature of women of color in engineering was 'being the only one'. This social pain can be translated into a sense of isolation that stems from being the only gender or race in an engineering classroom populated by white men. In this case, it can be said that these Hispanic women felt a higher degree of belongingness in their classrooms due to the majority population being Hispanic. One student, Paulina, said that she felt tokenized for being a Hispanic woman when she attended conferences or other engineering-related events outside of the university. This example could indicate that a Hispanic woman may eventually end up encountering these social pains due to her race later in her career without first experiencing them at an HSI

B. HISPANIC CULTURE COULD EMPHASIZE A STUDENT'S NEED FOR PERSISTENCE AND SUCCESS IN COLLEGE:

In a study conducted at the Massachusetts's Institute of Technology, researcher Susan S. Silbey [19] states that "Women make up 20% of engineering graduates, but it's been estimated that nearly 40% of women who earn engineering degrees either quit or never enter the profession." Other studies claim that women are leaving this degree due to the cultural influxes of the engineering field rather than for academic reasons[20]. While studies such as these display the commonly low rates of persistence in engineering among female students, the women interviewed during this study exhibited determination and a will to persevere. A key factor believed to have been impacting these women's persistence in achieving academic success is their Hispanic culture. Relevant literature has shown that the Hispanic ethnic group is known for forming strong bonds to its family and that there is a fount of strength drawn from familial relationships [21]. This concept of family importance within the Hispanic population is called familismo, defined as a "centrality of strong family ties within the family, simultaneously positioning the family as the key source of strength and support"[22]. Cultural pressures could also apply a need for persistence in college, as exemplified by student Olivia, who was told by her mother to tell her grandma that she wouldn't be graduating college if she decided to partake in a fellowship--indicating that dropping out of college would be shameful towards the family.

C. FAMILY HISTORY AFFECTS A WOMAN'S INTRODUCTION AND DESIRE TO BE IN ENGINEERING:

An interesting similarity that arose from interviewing these young women was their exposure to engineering through family members. 4 out of 6 of the women interviewed stated to have a relative either working in the industry or studying engineering alongside them. This is important to note as research shows that varying levels of family members (parents, siblings, and extended family) can have different volumes of influence on a woman's enrollment towards an engineering major[23]. Mulan and her twin brother are both engineering students. Siblings spend a lot of time

together and thus develop a co-partnership, with studies revealing that older siblings who have attended college play a role in their ability to provide guidance based on their personal experiences. In Mulan's case, her twin brother could provide a sense of partnership or rivalry that could further boast her participation within her engineering field. Abby cited her aunt and uncle, architect and civil engineer respectively, as two of her biggest exposures to STEM. Extended family members' influence is dependent on student's relationship with their parents and the level of education their immediate family possesses. Extended family members with a higher degree of education than the parents have a greater chance at impacting a student's college attainment [23]. Gender plays a part when examining the family influence phenomenon, as female and male students tend to rank their same-sex parents and siblings as affecting their college major choice more than their opposite-sex parents and siblings[23].

VII. Conclusion

Research for this study began at the heart of the COVID-19 outbreak and thus limited our pool of participants to only six. While six female engineering students are not enough to represent the entire female engineering population at this Hispanic-serving institution, their thoughts and experiences are still worth documenting and investigating.

The qualitative data analysis conducted within this study focused on the experiences of female engineering students at a Hispanic Serving Institution. Within this study's results and discussions were several findings that could guide future qualitative research regarding women in STEM. Most notably, the women interviewed during this study contrasted differently in comparison to what the literature depicted a woman in STEM to be. The women interviewed all recounted a level of success within their field and a perseverance to graduate within their respective major. When considering the conceptual framework of intersectionality, the women interviewed in this study claimed their Hispanic ethnicity did not play a negative role in their experience as a female engineering student and in fact helped them to feel a sense of belonginess.

Further research could investigate a larger group of female engineering students from varying races and ethnicities and their experiences at a Hispanic serving institution. Other factors that may help to create a more diverse pool of interviewees include class rank, their level of involvement within engineering, and the location of their respective campus.

REFERENCES

[1] B. Khan, C. Robbins, and A. Okrend, "The State of U.S. Science and Engineering 2020," *Natl. Sci. Board Sci. Eng. Indic.*, 2020.

[2] M. Ong, N. Jaumot-Pascual, and L. T. Ko, "Research literature on women of color in undergraduate engineering education: A systematic thematic synthesis," *J. Eng. Educ.*, vol. 109, no. 3, pp. 581–615, 2020, doi: 10.1002/jee.20345.

[3] K. Hamrick, "National Science Foundation Statistics on Women, Minorities and Persons with Disabilities in Science & Engineering," *Natl. Sci. Found.*, 2019.

[4] M. Jarvie-Eggart, A. Singer, and J. Mathews, "Parent and Family Influence on First-year Engineering Major Choice," *2020 ASEE Virtual Annu. Conf. Content Access Proc.*, 2020.

[5] J. Roy, "Engineering by the numbers," *Am. Soc. Eng. Educ.*, 2020.

[6] B. E. Rincón, "Does Latinx Representation Matter for Latinx Student Retention in

STEM?," *J. Hispanic High. Educ.*, vol. 19, no. 4, pp. 437–451, 2020, doi: 10.1177/1538192718820532.

[7] T. J. Yosso, "Whose culture has capital? A critical race theory discussion of community cultural wealth," *Race Ethn. Educ.*, vol. 8, no. 1, pp. 69–91, 2005, doi: 10.1080/1361332052000341006.

[8] R. W. Lent, S. D. Brown, and G. Hackett, "Toward a Unifying Social Cognitive Theory of Career and Academic Interest, Choice, and Performance," *J. Vocat. Behav.*, vol. 45, no. 1, pp. 79–122, 1994, doi: 10.1006/jvbe.1994.1027.

[9] Z. T. Azizova and P. P. Felder, "Understanding racial/ethnic meaning making," *Stud. Grad. Postdr. Educ.*, vol. 8, no. 2, pp. 144–168, 2017, doi: 10.1108/sgpe-d-17-00004.

[10] G. Lent, R.W. & Brown, S.D. & Hackett, "Social Cognitive Career Theory," *Career Choice Dev.*, vol. 4th Editio, pp. 255–311, 2002.

[11] R. A. R. Alonso, "Engineering identity development of latina and latino members of the society of hispanic professional engineers," *ASEE Annu. Conf. Expo. Conf. Proc.*, vol. 122nd ASEE, no. 122nd ASEE Annual Conference and Exposition: Making Value for Society, 2015, doi: 10.18260/p.23967.

[12] R. R. Alonso, "Work in progress: Understanding the experiences of women of color in engineering," *Proc. - Front. Educ. Conf. FIE*, pp. 14–15, 2012, doi: 10.1109/FIE.2012.6462330.

[13] G. A. Cadenas *et al.*, "Racial/Ethnic Minority Community College Students' Critical Consciousness and Social Cognitive Career Outcomes," *Career Dev. Q.*, vol. 68, no. 4, pp. 302–317, 2020, doi: 10.1002/cdq.12238.

[14] K. Crenshaw, "Demarginalizing the Intersection of Race and Sex: A Black Feminist Critique of Antidiscrimination Doctrine, Feminist Theory, and Antiracist Politics [1989]," *Fem. Leg. Theory*, pp. 57–80, 2018.

[15] K. Cross, K. Clancy, R. Mendenhall, P. Imoukhuede, and J. Amos, "The Double Bind of Race and Gender: A Look into the Experiences of Women of Color in Engineering," *2017 ASEE Annu. Conf. & Expo. Proc.*, 2017.

[16] S. M. Malcolm, P. Q. Hall, and J. W. Brown, "The double bind: the price of being a minority woman in science," *Washington, D.C. Am. Assoc. Adv. Sci.*, 1976.

[17] S. L. Eddy and S. E. Brownell, "Beneath the numbers: A review of gender disparities in undergraduate education across science, technology, engineering, and math disciplines," *Phys. Rev. Phys. Educ. Res.*, vol. 12, no. 2, pp. 1–20, 2016, doi: 10.1103/PhysRevPhysEducRes.12.020106.

[18] J. A. Ericksen, "WOMEN PURSUING NONTRADITIONAL CAREERS : A SOCIAL COGNITIVE CAREER THEORY PERSPECTIVE," no. May 2002, 2013.

[19] S. S. Silbey, "Why Do So Many Women Who Study Engineering Leave the Field?," *Harv. Bus. Rev.*, 2016, [Online]. Available: https://hbr.org/2016/08/why-do-so-many-women-who-study-engineering-leave-the-field.

[20] S. S. Silbey, "Opinion: The big reason women drop out of engineering isn't in class," *MarketWatch*, 2016, [Online]. Available: https://www.marketwatch.com/story/the-big-reason-women-drop-out-of-engineering-isnt-in-the-classroom-2016-06-30.

[21] F. A. Marrero, "Exploring factors that contribute to academic persistence for undergraduate hispanic nontraditional students at hispanic serving institutions in the southeast," *Lib. Univ.*, 2013.

[22] M. Wolley, "Supporting School Completion among Latino Youth: The Role of Adult Relationships," *Prev. Res.*, 2009.