

Exploring the Significance of Internship Experiences for the Career Development of Racially Minoritized Undergraduate Engineering Students

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Abstract— Within engineering, internship experiences are upheld as a high-impact practice for students to increase practical knowledge and gain workforce preparation. The purpose of this paper is to explore the impact of participating in an engineering internship on the career development of racially minoritized students. We used a quasi-experimental research design to examine the experiences of racially minoritized students who participated in an internship program, titled Corporate Scholars, hosted by the National Action Council for Minorities in Engineering (NACME), during the Summer of 2022. We conducted a one-group pretest-posttest design followed by semi-structured interviews with a subset of the participants. Pre-and post-survey responses were collected for 33 students, and interviews were conducted with 10 of the 33 students.

We found that students had a range of experiences with their company that influenced their perceptions of their internship, their company, and the field of engineering. The internship experience appeared to impact vocational identity and building occupational interest. Additionally, we found tensions in students' perceptions of engineering as a result of their internship and found that their perceptions of their company were dependent on mentor's and workplace support. The results of this work could provide useful insight into how to better support engineering students, inform program practices, and increase retention in the field of engineering.

Keywords—undergraduate, internships, vocational identity

I. INTRODUCTION

Internship experiences in engineering are upheld as a high-impact practice for students to increase practical knowledge and gain workforce preparation. The benefits of participating in internship programs for engineering students are well documented in the literature, including, but not limited to, academic benefits, retention in engineering, preparation for first position post-graduation, and career outcomes [1-6]. Additionally, as a high-impact practice, engineering internships provide an opportunity to support broadening participation in the engineering workforce and retention of minoritized engineers [7].

Although there has been research on the experiences of engineering students in internships, there is little research on the experiences and workforce development of racially minoritized students in this context. Furthermore, there is less known about vocational identity, perceptions of engineering, and perceptions of companies as a result of internship participation.

The purpose of this paper is to explore the career construction of racially minoritized students in an internship program. Specifically, we studied the perceptions of students who participated in an internship program, titled the Corporate Scholars, hosted by the National Action Council for Minorities in Engineering (NACME). NACME is the largest provider of scholarships for college students from underrepresented racial/ethnic groups pursuing undergraduate engineering degrees—amounting to over \$3 million in scholarships awarded annually to approximately 1,000 students. The Corporate Scholars program is a NACME partnership between over 46 universities and 26 corporations. Over the summer, students from the partnering universities complete a 9-13 week paid internship at a partnering corporation.

To examine workforce development of the NACME Corporate Scholars during their internship, this study is guided by the following research questions:

- R1) How were students' vocational identity and occupational interest impacted by having an internship experience?
- R2) How were students' perceptions of engineering impacted by having an internship experience?
- R3) How were students' perceptions of their company significant in students' internship experiences?

II. BACKGROUND

A. Literature Review

As discussed, the benefits of engineering internships as a high-impact practice have been well documented [7]. While these are positive outcomes, there is less literature on workforce development focused on racially minoritized engineering students. For example, Dietz [8] stated there is little focus on the internship experiences of Black engineering students and that it is important to study this space because internships are a “liminal space between school and career” (8, pp. 22). Exploring the workforce development of racially minoritized students is also important considering the purpose of engineering internships and engineering education to prepare students for the engineering workforce. Our research questions were guided by three major areas of inquiry for this study: vocational identity, perceptions of engineering, and perceptions of their company.

Vocational Identity in Internships

Vocational identity is defined as “having a clear and secure understanding of one’s career goals, abilities, educational interests, and personal values” [9, pp. 68; 10]. Vocational identity is commonly used in the field of vocational education, however, is it not as widely applied to engineering contexts. Prior studies conducted on racially minoritized students in engineering internships have primarily focused on the impact of internship experiences on racial and engineering identity development [8]. Additionally, work has been conducted on the intersection of vocational, racial, and gender identities for women of Color in STEM broadly [9-14].

Perceptions of Engineering

Students’ perceptions of engineering are important to consider as they influence intent to persist in the field and career decisions [15]. There has been work conducted on pre-college and undergraduate engineering students in the classroom. In the pre-college space, for example, Hammack and colleagues [16] studied the effect of a summer program on students’ perceptions of engineering and technology. Additionally, Thompson and Lyons [17] explored the perceptions of engineering held by 6th grade African American students and noted the importance of understanding the engineering perceptions of racially minoritized students. In the engineering undergraduate space, several scholars have explored students’ perceptions of the field of engineering and engineering disciplines [15; 18-19]. However, much of the work conducted undergraduate students’ perceptions of engineering have been within the context of the classroom and there has been less work focused on understanding the perceptions that racially minoritized engineering undergraduate students have of engineering.

Overall, there has been little work focused on students’ perceptions of engineering as a result of participating in an internship, despite internships being a high-impact practice and a significant learning experience for engineering students.

Perceptions of the Company

Perceptions of the company included students’ thoughts and opinions regarding the company and site they worked at for the duration of their internship. Perceptions of the student’s company are important to explore, particularly as it relates to work experience and intent to return because these can influence retention in engineering careers. Some work has been conducted assessing students’ perceptions of their internship programs as facilitated by the program staff and company [20-

22]. Additionally, several scholars have used the Work Experience Scale to explore engineering students’ perception and satisfaction with their internship experience [23-24].

Overall, while there have been many separate studies inside and outside the context of engineering on identity, internships, and workplace culture [8] there is a lack of work focused on understanding workforce development of racially minoritized students in engineering internships.

B. Framework

The guiding framework utilized for the overall research project was Career Construction Theory (CCT). CCT is primarily used in career counseling spaces to identify how individuals manage the challenges and responsibilities that come with navigating a career as well as to help people cultivate and apply their vocational self-concept [25].

More specifically, the construct of CCT that was used to guide the activities NACME interns participated in was *Career Adaptability Resources*, which states the extent to which a person is able to cope with challenges and responsibilities in one’s career [26]. Savickas and Porfeli [27] identified 4 dimensions of career adaptability resources: 1) concern, 2) control, 3) curious, and 4) confidence. Concern refers to the consideration an individual has about the future. Control refers to the self-discipline, effort, and persistence an individual enacts in response to contextual-related demands. Curiosity refers to a person’s ability to imagine and seek out various occupational roles. And lastly, confidence refers to a person’s ability to pursue their career objectives and/or ambitions [27]. Each of these dimensions informed the design of the programming and also supported the development of the instruments used to collect information (e.g., interview protocols, questionnaire, reflection prompts) from the students.

For the purposes of this paper, our survey and instrument used CCT as a guiding framework to increasing our understanding of the workforce development of racially minoritized students participating in engineering internships. For the survey, we also used scales measuring specific sub-constructs that aligned with the framework, such as Vocational Identity, Engineering Identity, and Organizational Commitment. These scales align with the overall purpose of exploring workforce development and with Savickas’ theory [25].

III. METHODS

This research study utilized a quasi-experimental design [28]. More specifically, we used a single-sample, pretest-posttest. We chose this research design because a) random assignment was not possible and b) we did not have access to a control group. To address the limitation of not having a control group, we chose to supplement this research design with semi-structured interviews that would enable us to bolster our quantitative insights with qualitative data. Data was collected during the summer and fall of 2022 as part of the 2022 NACME Corporate Scholars internship program. Preliminary qualitative findings were discussed in prior work [29].

A. Pretest, Posttest (N=33)

We collected quantitative data using a survey instrument. The goal of the survey instrument was to collect data that would enable us to examine the impact of participating in an internship. The survey instrument focused on: 1) engineering identity [30], 2) vocational identity [31], 3) reasons for accepting the internship, 4) organizational commitment [32], 5) intent to return [33-34], and 6) overall work experiences over the summer [23]. Combined, these constructs and focus areas highlight the awareness of students' identity formation, career goals, and organizational involvement which relate to career adaptability resources. More specifically, engineering identity and vocational identity relate to the career adaptability resource dimension of concern, the consideration an individual has about the future [27]. Organizational commitment and intent to return relate to the dimension of control or the self-discipline, effort, and persistence an individual enacts in response to contextual-related demands [27]. Reasons for accepting the internship relate to the dimension of curiosity, a person's ability to imagine and seek out various occupational roles [27]. Lastly, students' overall work experiences relate to the dimension of confidence, a person's ability to pursue their career objectives and/or ambitions [27]. While we designed the survey to examine the impact of participating in an internship and aligned aspects of the survey with dimensions of career adaptability resources, the results demonstrated the dimensions of career adaptability resources across the four hypotheses.

The pretest and posttest occurred during the summer of 2022. Pre-and post-survey responses were collected for 33 students.

A paired-samples t-test was used to determine whether there was a statistically significant mean difference between students' vocational identity score before the internship and after the conclusion of the internship. Since we were aiming to identify where or not there was a statistically significant mean difference our hypotheses focus on examining if the chosen outcomes were impacted at all by having an internship experience. Specifically, our hypotheses were the following:

- H1. Vocational identity will be impacted by having an internship experience
- H2. Perceptions of engineering will be impacted by having an experience
- H3. Quality of the experience will generate positive perception of the company
- H4: Intentions to persist will be impacted by workplace support

B. Interviews (N=10)

We collected qualitative data using a semi-structured interview protocol with 10 students sampled from the 33 students who completed the pre/post surveys. The goal of the interview protocol was to elicit insights that would enable us to more deeply explore students' experiences and our quantitative results. The interview protocol focused on students' perceptions of their internship placement, their vocational identity, and the field of engineering. In addition to adding context to our quantitative data, to create the interview protocol we also drew upon prior qualitative studies on engineers'

transition to the workplace [35] and internships as a mechanism of anticipatory socialization [36]. Our interviews with NACME Corporate Scholars occurred during fall of 2022, following purposeful sampling of the participants that completed both the pretest and posttest. Each student was allowed to choose their own pseudonym for the purposes of this study and analysis. All the names included in this paper reflect the participants chosen pseudonyms, not their real names. Additionally, where quotes are used, we note the participant's pseudonym and their self-identified race and gender for additional context.

The interviews were analyzed using thematic analysis as informed by Braun and Clarke [37]. For the purposes of this paper, we focused on themes related to vocational identity, perceptions of engineering, perceptions of their company, and overall quality of their experience to provide additional context to our hypotheses and quantitative data.

IV. RESULTS

1. *H1. Vocational identity would be impacted by having an internship experience*

A paired-samples t-test was used to determine whether there was a statistically significant mean difference between students' vocational identity score before the internship and after the conclusion of the internship. The vocational identity scale was based on a composite score of 9 items that captured students' Vocational Identity Scale (VIS) [31]. Students' post-vocational identity score, after the internship experience, was greater (mean = 3.80, SD = 0.76) compared to their pre-vocational identity score (mean = 3.53, SD = 0.73). The increased vocational identity score of 0.27 after the internship experience was statistically significant, $t(32) = -3.09$, $p < .0002$, with a medium Cohen's d effect size of 0.54. Indicating that students overall vocational identification was positively reinforced as a result of their internship experience.

We also examined the individual items within the vocational identity scale to try and capture the more granular differences that lead to their increased identity score. We found that after the internship, students had a clearer sense of occupational interest (mean = 4.09, SD = 0.98) compared to before their internship (mean = 3.67, SD = 0.99). The mean difference of 0.42 was statistically significant, $t(32) = -2.70$, $p < .0005$, with a small Cohen's d effect size of 0.47. Indicating that the internship experience served to solidify their occupational interest. This demonstrates that the internship experience had an influence on the dimensions of concern and curiosity.

We also found that after the internship experience (mean = 3.97, SD = 0.88), students had a better understanding of the type of occupation they would enjoy doing in the future compared to before their internship (mean = 3.70, SD = 0.92). Results from the pairwise t-test produced a significant alpha value of $t(32) = -1.87$, $p < .036$, with a small Cohen's d effect size of 0.19. Similarly, after their internship experience, students felt they could more readily envision the kind of work they want to do for a living (mean = 3.88, SD = 0.89). Their mean scores significantly increased 0.21 points compared to before their internship experience (mean = 3.67, SD = 0.92), $t(32) = -1.88$, $p < .035$, with a small Cohen's d effect size of 0.33. An increased understanding of the type of occupation and feeling like they could more readily envision the kind of work they

want to do additionally demonstrates an influence on the career adaptability resources dimensions of concern and curiosity.

These results should be interpreted with caution as the effect size was not large enough to pass the minimum threshold of 0.45 determined in the power analysis. Future work will need to consider increasing the sample size in order to increase the power (i.e., confidence) in the difference being observed.

H1. Qualitative Insights

Our qualitative findings for hypothesis 1 supported the quantitative results. Across the board, the 10 students we interviewed discussed changes in their vocational identity from their internship.

The increased occupational interest seemed especially prevalent for students who experienced their first engineering internship. For example, one student Abby discussed how before she chose Civil Engineering as her field of study based on her interest and advice she received from others,

When I was younger, I wanted to be an artist, and someone told me that I wouldn't make a living being an artist. They were like, "You need to find a real job." So yeah, I settled on civil engineering because it was kind of close to architecture, but I didn't think I was that good at being an artist. So, I was like, "Okay, civil engineering is close." But I didn't know exactly what I wanted to do. I just knew I liked buildings. . . So, I knew I wanted to do something with that, but I didn't know exactly what. [Abby, Latina Woman]

Abby knew that she had broad interest in creative endeavors, however, her prior occupational interest was not as strongly tied to engineering or her field of civil engineering. Reflecting on her internship experience, Abby went on to tell interviewers *"I think I learned more about what I actually want to do in a job."* [AA0604-Abby]. This sentiment also is an example of the quantitative finding that students reported a better understanding of the type of occupation they would enjoy doing in the future compared to before their internship.

The students also discussed vocational identity in terms of being able to more readily envision the kind of work they want to do for a living, in alignment with our quantitative results. A student, Dani, told interviewers:

I saw myself just working anything web development, but in my head, I was like, "I'll just stick with one company and then that'll be it." But now I'm a little bit more open to, "Hey, maybe I ... maybe I don't have to stay with [Company] for the rest of my career. Maybe I can make my own software company. Maybe I'll explore another career path down the future." Just the fact that you can do anything that you want. I think [Company] really just put that in my head. I can do whatever I want. It's flexible. I think it just made me more open minded. [Dani, Black Woman]

After her internship, Dani's view of her possible career path was changed, and she was able to more readily envision new pathways.

Another student, Nairobi, discussed a similar change in mindset due to his internship. Nairobi stated,

I learned that I want to do product design engineering, but I did realize that I want to be at least designing something somewhat interesting. This company engineered and they designed diaphragm valves, which I was not very interested in at all. So, I've been looking at all these design companies . . . [now] I also look at what they're designing and whether I would enjoy that or not. [Nairobi, Black Man]

While Nairobi completed an internship in product design, a field that he had been interested in, he realized during his internship that the type of product influenced his interest in the work. As a result of his internship experience, this knowledge of the kind of work he wants to do in product engineering has changed and is influencing his current search for a full-time position.

H2. Perceptions of engineering would be impacted by having an experience

Our second hypothesis examined whether students' perceptions of engineering would be impacted by their internship experience. We asked students to respond to a battery of survey items pertaining to factors that they believed were necessary to be considered an engineer or computer scientist [30]. Through the pre-and post-survey, we were able to capture differences in their perceptions of what was important to be considered an engineer or computer scientist. Among the list of 14 items, we found only one significant change in their perceptions. Interestingly, students' perceptions of being able to work with others by sharing ideas as a necessary factor for being thought of as an engineer or computer scientists significantly **decreased by** 0.42 points after students' internship (post-internship mean = 4.36, SD = 0.86) compared to before their internship (pre-internship mean = 4.78, SD = 0.48), $t(32) = -2.43, p < .01$. However, the effect size was small, Cohen's d effect size of 0.42 and therefore falls short of achieving the power analysis threshold value of 0.45 given the sample size, $n=33$. This finding relates to the dimensions of concern and control in terms of the skills needed for their future occupation. Future work will need to explore this decrease in mean score by looking into why sharing ideas might lead to negative views about what is necessary to be considered an engineer or computer scientist.

H2. Qualitative Insights

In terms of whether students felt that their perceptions of engineering were impacted by their internship, we found tensions in the qualitative data. These tensions align with the quantitative results, which only found a significant decrease in students' perceptions of being able to work with others by sharing ideas as a necessary factor for being thought of as an engineer or computer scientist. While the majority of the students felt that their perceptions of engineering changed as a result of their internship, there were several students who felt that their overall perceptions did not change. However, students did not discuss sharing ideas as a factor related to being thought of as an engineer or scientist or their perceptions of engineering.

In terms of students who felt that their perceptions of engineering had changed, the most commonly cited reasons were due to the professional exposure they experienced in their internship compared to the classroom. Similarly, to the prior

section, the students who had their first internship all stated that their perceptions had changed as a result of their experience. For example, Nairobi told interviewers:

I think my perception of engineering changed. It changed slightly to the fact that I think there's just a lot that goes into it. There's more than what you just learn at school, you know what I mean? . . . Just the way engineering operates. When I was at the company, there's just a lot going on overall whether it's producing something or whether it's communicating with two different people. [Nairobi, Black Man]

Nairobi realized that engineering is a lot broader than he had initially learned in his engineering coursework, especially in the day-to-day operations of the company they interned with.

Dani also discussed how her perceptions of engineering had changed compared to her classroom experience and expectations. She stated,

I always thought the engineering world was so professional. Yes, it is professional, but it's not as professional as I thought it was. People use emojis when they email each other, and I don't have to be so formal. I thought that was so cool though, because it takes the pressure off. . . . I think maybe every sector of engineering experience is some form of imposter syndrome in that we're all just trying to just get somewhere. . . . It just made me feel more a part of engineering, I guess you could say. I was so in my head, just so scared, and now it's like, 'Okay, the industry's just not that scary. I can do this.' [Dani, Black Woman]

In this case, Dani's perceptions of engineering changed in a positive way after her internship and as a result she felt "more a part of engineering" than she had previously. Exposure to engineering work allowed that engineering was something she could "do" through her statement of "I can do this". Both Dani and Nairobi's first internship were in the summer of 2022 with the NACME Corporate Scholars program.

On the other hand, several students did not feel that their perceptions of engineering had changed after their internship experience. These students all had prior internship or research experiences. An example of a student who did not feel that their perceptions of engineering had changed much was Iris who told interviewers,

I'd say that in terms of the higher-level view of engineering, I don't think it's necessarily changed that much because I still view it as a problem-solving type of thing. But I'd say that it's changed my perspective in terms of what skills I can learn and the timeframe in which I can learn them. [Iris, Black Woman]

While Iris admitted that her perspective of learning had changed, her perceptions of engineering and her "higher-level view" of engineering was not as impacted as a result of her internship experience. Prior to her internship she viewed engineering as problem-solving and this perception was reinforced through her experience.

The tensions seen in the qualitative findings and the single quantitative finding for this hypothesis lead us to believe that

there is opportunity for further work in this space to explore students' perceptions of engineering and the skills they perceive are needed to be considered an engineer or computer scientist.

H3. Quality of the experience would generate positive perception of the company

In order to examine our third hypothesis, i.e., Quality of the experience would impact students' perception of the company, we conducted a multiple regression analysis using the post-internship survey responses. We used the "word of mouth" subscale from the Intentions to Return inventory [33-34], to capture students' perceptions of their company. Items from the word-of-mouth subscale include: "I would recommend this employer to someone who seeks my advice," "I say positive things about this employer to other people," and "I would recommend this employer to others." Students' positive perceptions of their company were based on two key strategies they experienced while at their internship. Specifically, working with a supervisor that motivated them to do their best work subsequently increased their positive company perception, standardized coefficient = 0.40, $p < .001$. Additionally, students held a positive perception of their company because they felt their internship helped develop their problem-solving abilities, standardized coefficient = 0.47, $p < .001$. These two strategies helped explain 60% (Adj. $R^2 = 0.60$) of the variance of company perception. These findings relate most closely to the curiosity and confidence dimensions.

H3: Qualitative Insights

The qualitative findings aligned with the quantitative findings regarding the quality of student's experience impacting the perception of the company for students who discussed the quality of their experience positively as well as students who discussed their internship experience as negative. Additionally, the majority of the qualitative interviews discussed the influence of one's supervisor or work team as defining the quality of their experience and thus their perception of the company. This aligns with the key strategy of working with a supervisor that motivated them to do their best, however, there were few students who discussed problem solving in relation to the quality of their experience.

Several students discussed having a positive internship experience and a positive perception of the company. For example, Abby told interviewers that she had a high-quality experience and that she intended to return because of it,

I think my internship set pretty high standards and now I just want to work for them and advance in the company if anything. I wouldn't want to leave it. [Abby, Latina Woman]

In her interview, Abby spoke positively about her relationship with her supervisor and her team which in turn led to her not wanting to leave due to her relationships and the work environment. This quote demonstrates her perceptions of her company as a result of the quality of her internship experience.

Another example of a student who had positive internship experiences and positive perceptions of their company was Lebron. He discussed his relationship with his team and the

overall culture at the company as positive, despite prior misconceptions that interns are treated badly.

I feel like I was accepted well into the family. There's this common misconception with interns that they're kind of the weaker link and the whole stereotype with the interns, get you the coffee and they're kind of disrespected. It was completely the opposite for me. I felt accepted. Everyone was incredibly nice and patient with me. [Lebron, Latino Man]

On the other hand, there were some students who discussed having a negative internship experience and a negative perception of the company. One of the most extreme examples of this is Jules, who reported that he had a negative quality of experience and negative perceptions of the company he interned for due to his interactions or lack thereof with his mentor and team. Jules told us that over the course of his summer internship he only met with his assigned supervisor three times in person. He went on to explain:

Basically, in the span of my time there, I had two managers, both of them, both of them were vacant for most of the internship . . . I think most of our managers didn't really express a fond closeness to the work that they were doing. The other one of our mentors was trying to leave the site for most of the time and eventually became successful [and left] towards the very end. [Jules, Black Man]

In this case, Jules reported that his managers were very hands off and he also believed that they did not like the work that they were doing, which influenced how much help they gave Jules in return. This lack of engagement also affected how Jules perceived the company and the company's culture,

The culture at [Company] is quite direct. I think most tech companies don't hold back in terms of technical criticism and that's useful. But sometimes it was technical criticism without resources to understand the criticism nor resources of other particular solutions or good feedback, constructive feedback. [Jules, Black Man]

Jules' negative internship experience was influenced by his supervisors, which affected his perceptions of the company. Overall, the students' quality of the experience appeared to be related to their perceptions of the company and the qualitative data aligns with the quantitative support for the hypotheses.

H4: Intentions to persist will be impacted by [perceptions of company] support

To examine the factors that would inform students' intentions to persist in their respective professional field we conducted a multiple regression analysis using workplace support as predictors [32]. We created a composite score to measure intentions to persist using the following two survey items: "I intend to continue pursuing professional opportunities in my field of study" and "I plan career opportunities beyond my field of study." We found that students' intention to persist in their field increased as a result of having a supervisor who tried to make their work experience more interesting, standardized coefficient = 0.31, $p < .019$ and when they were given useful feedback at work, standardized coefficient = 0.29, $p < .027$. Overall, these two workplace support strategies helped

explain 22% (Adj. $R^2 = 0.22$) of the variance in intention to persist in their field. Similarly, to H3, these findings relate most closely to the curiosity and confidence dimensions.

H4: Qualitative Insights

The qualitative findings supported the quantitative results and we saw that students' intentions to persist in engineering jobs was impacted by workplace support and perceptions of the company. Many students discussed their supervisors and teams as key strategies of workplace support that affected their intent to return to the company. Intentions to persist were often discussed by the students as whether or not they would return to the company and persist in that role or if they would persist in the same engineering discipline. Additionally, one strategy that was not captured by the quantitative data was the impact of other interns on workplace support and intent to return.

Abby, who had a positive experience in her internship, positive perceptions of her supervisor, and positive perceptions of the company told us that she was planning to stay with her current company for her next role:

So, I am hoping I can stay with them and I'm hoping that it continues to go well and it's something that I still like doing in the future. If not, and something else comes across me and something that I think is cool to try, then I'll try it. But I can't imagine that there would be a better job that I would prefer to be at. [Abby, Latina Woman]

While she noted that she would try something else if it came up, Abby told us that after her internship experience, she could not imagine a better job due to her positive experience with her supervisor and team. This demonstrates a strong intent to persist in engineering and an intent to return to the same company she interned with.

Another student, Dani, discussed the intent to persist in terms of how her internship work and supervisor made her realize that she does not need to be perfect and that the workplace felt more supportive than the classroom. She said,

I was just like, "Oh my gosh, what if they realize that I don't know anything and that they chose a really bad intern?" That was literally my mindset every day. Then I think I slowly got out of that when my mentor, he was just so willing to answer my questions... Then I think through that I just learned that I'm going to mess up and I can't be perfect. I won't know everything. I think really school just got us into this mindset of this is how it is, you need to be perfect, and it needs to look like this, and that's not the case. [Dani, Black Woman]

This quote demonstrates a shift in mindset during her internship, which shaped how she viewed engineering work as well as her coursework. She went on to say that she felt that the school to workforce transition will be challenging due to the differences she identified but in this discussion her intent to persist into an engineering career post-graduate was strong.

The quantitative findings found that intern's supervisors and feedback were key strategies of workplace support which affected intent to persist. One aspect of workplace support that was not measured quantitatively but came up in the qualitative interviews was the presence of other interns as a strategy of

workplace support. In terms of workplace support and intent to return, Nairobi stated that he was not sure if he would return to the company to work due to other interns' being a big component of workplace support, he received. When asked if he would accept a return offer to go back to the company full-time, he said,

This is a very, it's a hard one because I think I would. I'm split between it. I would, and I wouldn't. The ups and downs to it are almost equal. But I think if they were to give me a job offer right now, I think I would. But the only reason why I would say no would be simply because I feel like my experience was really, really good at the internship simply because there was another intern there. [Nairobi, Black Man]

While Nairobi said he would potentially consider returning, the significance of other interns in his experience is worth noting. Throughout our interviews many students discussed the significance of other interns and other interns from marginalized backgrounds on their own experience. In the future, it would be worth deeper exploring the influence of intern pairing or groupings on perceptions of workplace support and intent to return.

V. DISCUSSION

The findings from this study reflect several important takeaways for internships in engineering, such as the importance of internships for career construction as well as students' vocational identity, the potential for tension in the students' perceptions of engineering, and the role of student perceptions of the company, whether that be the individual mentor or team, on the students' overall internship experience.

R1) How were students' vocational identity and occupational interest impacted by having an internship experience?

In regard to students' vocational identity and occupational interest, Hypothesis 1 found that students' overall vocational identification was positively reinforced as a result of their internship experience. Additionally, it was found that students had a clearer sense of occupational interest, especially prevalent for students who experienced their first engineering internship, and they reported a better understanding of the type of occupation they would enjoy doing in the future compared to before their internship.

R2) How were students' perceptions of engineering impacted by having an internship experience?

While exploring whether students felt that their perceptions of engineering were impacted by their internship, we found tensions across participants in Hypothesis 2. The quantitative results only found a significant decrease in students' perceptions of being able to work with others by sharing ideas as a necessary factor for being thought of as an engineer or computer scientist. In our qualitative interviews while the majority of the students felt that their perceptions of engineering changed as a result of their internship, there were several students who felt that their overall perceptions did not change. Overall, these tensions signify an area of future exploration.

R3) How were students' perceptions of their company significant in students' internship experiences?

Lastly, through Hypotheses 3 and 4, we found that students' positive perceptions of their company increased based on working with a supervisor that motivated them to do their best work or if they felt their internship helped develop their problem-solving abilities. Qualitatively we found that students' positive or negative experiences were often related to a supportive supervisor and/or team. Finally, we found that students' intention to persist in their field increased as a result of having a supervisor who tried to make their work experience more interesting. Many of our students discussed persisting in the field of engineering, however, their choice to persist or stay at their job was based on their workplace and supervisor support.

Overall, our findings also demonstrated several dimensions of the Career Adaptability Resources dimensions informed by Career Construction Theory [26-27]. We found that different dimensions of the five Career Adaptability Resources dimensions related to different aspects of students' internship experiences. Students' vocational identity and occupational interest related most to the dimensions of concern and control. These dimensions were also related to students' perceptions of engineering as a result of their internship. In terms of students' perceptions of their company we found that the dimensions of curiosity and confidence were most related.

There are some limitations to this study. First, although there were 32 participants who completed both the pre- and post- survey, we sampled ten students for interviews for the qualitative portion of this study. While we analyzed the data to saturation, it is possible that because we did not interview all 32 students, we did not fully qualitatively capture the experiences reflected in the quantitative data. Additionally, as mentioned in the quantitative analysis, future work with another program or larger population of students may provide additional quantitative insights.

VI. CONCLUSIONS AND IMPLICATIONS

These findings provide a deeper understanding of student experiences in an engineering internship program by utilizing quantitative pre- and post-test data and qualitative semi-structured interview data. In this study, we found that students had a wide spectrum of experiences with their internship placement and these experiences reflected in their career plans in terms of the constructs of vocational identity, intentions to persist in their professional field, and perceptions of engineering. This paper contributes to the existing body of work on engineering internships by providing context to marginalized engineering students' vocational identity, perceptions of their company, and perceptions of engineering as a result of participating in an internship.

As demonstrated in this study, there is potential for future alignment between quantitative and qualitative data collection for studies on engineering students' perceptions and their internship experiences. Using the pre- and post-survey design, we were able to capture information on engineering identity, vocational identity, reasons for accepting the internship,

organizational commitment, intent to return, and their overall experiences. We used the interviews as an opportunity to follow-up on their responses in the survey and ask additional questions, specifically related to the students' experiences with their internship program.

Additionally, this study uniquely focused on an internship program that provides placement matching and supplemental professional development externally to the company partners. The structure of the NACME Corporate Scholars program provides a unique opportunity for intentional program assessment and professional development for interns. The program places interns with 26 companies at different sites and across different disciplines, therefore, future work could promote the continuation or incorporation of effective practices for intern professional development across company sites. Additionally, companies and internship practitioners should consider including intentional assessment to explore and understand the experiences of interns in their programs. Particularly, based on the findings of this study, we believe that it would be useful for practitioners to assess perceptions of the company, workplace support, and mentorship.

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