

Construction Research Congress 2024, Conference Proceedings

The Evolving Career Aspirations of Socially Minded Engineering and Construction Students

--Manuscript Draft--

Manuscript Number:	CRC2024-D-23-00460R2
Article Type:	Full Paper
Full Title:	The Evolving Career Aspirations of Socially Minded Engineering and Construction Students
First Author:	Emma Sophie Stine, Ph.D.
Corresponding Author:	Emma Sophie Stine, Ph.D. CU Boulder: University of Colorado Boulder UNITED STATES
Corresponding Author's Institution:	CU Boulder: University of Colorado Boulder
Keywords:	Career Pathways; Humanitarian Engineering; education
Section/Category:	Track 6: Construction Education, Workforce, Diversity, and Inclusion
Manuscript Region of Origin:	UNITED STATES
Abstract:	Humanitarian Engineering (HE) programs are growing exponentially to meet the rising demand of engineering and construction students wanting to address equitable infrastructure service provision. This field is attracting students traditionally underrepresented in engineering and construction, including those of diverse backgrounds, identities, and passions. However, there is a dearth of research tracking students' evolving career aspirations through the influences of graduate school. This study conducts longitudinal interviews with seven students enrolled in seven graduate HE programs over two years. Through these interviews, students' career aspirations were collected and qualitatively coded, including desires around impact, daily tasks, work environment, location, and compensation. The study identified three expectation patterns of shifts in career interests over a graduate education. This ongoing analysis will address the shortage of research on the career pathways of socially-minded engineering and construction students. Results will be valuable for programs to support and meet the changing needs and aspirations in these fields.
Additional Information:	
Question	Response
Corresponding Author E-Mail:	emma.stine@colorado.edu
Manuscript Classifications:	Construction Education
Other Authors:	Amy Javernick-Will
	Tiera Tanksley

The Evolving Career Aspirations of Socially Minded Engineering and Construction Students

Emma Stine.,¹ Amy Javernick-Will²; and Tiera Tanksley³

¹Department of Civil, Environmental, and Architectural Engineering, College of Engineering, University of Colorado, Boulder. Email: emma.stine@colorado.edu

²Full Professor, Department of Civil, Environmental, and Architectural Engineering, College of Engineering, University of Colorado, Boulder. Email: amy.javernick@colorado.edu

³Faculty Fellow, Center for Critical Internet Inquiry, University of California Los Angeles

ABSTRACT

Humanitarian Engineering (HE) programs are growing exponentially to meet the rising demand of engineering and construction students wanting to address equitable infrastructure service provision. This field is attracting students traditionally underrepresented in engineering and construction, including those of diverse backgrounds, identities, and passions. However, there is a dearth of research tracking students' evolving career aspirations through the influences of graduate school. This study conducts longitudinal interviews with seven students enrolled in seven graduate HE programs over two years. Through these interviews, students' career aspirations were collected and qualitatively coded, including desires around impact, daily tasks, work environment, location, and compensation. The study identified three expectation patterns of shifts in career interests over a graduate education. This ongoing analysis will address the shortage of research on the career pathways of socially-minded engineering and construction students. Results will be valuable for programs to support and meet the changing needs and aspirations in these fields.

INTRODUCTION

Humanitarian Engineering (HE) educational programs have grown exponentially in prevalence and popularity over the past few decades (Smith et al. 2020). The HE field focuses on addressing marginalized communities' infrastructure design, construction, and service delivery through the use of interdisciplinary approaches. Historically, HE programs have also had greater racial and gender diversity than traditional programs in engineering (Boy 2021; MacDonald et al. 2022; Swan et al. 2014; U.N. 2013). While these programs are touted for attracting a diverse set of motivated students that wish to learn and apply skills on tough infrastructure challenges, there is a dearth of information on these students' career aspirations and trajectories of these students. Specifically, we know little about the career outcome expectations these students have that initially draw them to the HE field, nor do we understand how these expectations fluctuate as students learn more about the field.

Career outcome expectations are defined as anticipated consequences from engaging in a specific career (SCCT). These include expected social benefits (salary, prestige, power), self-satisfying benefits (pride, enjoyment, happiness), and physical benefits (stress, strength, pain) of a career (Lent et al. 2007).

This research will track student outcome expectations of a career in the HE field over two years. In particular, we will characterize career outcome expectations that initially draw students to the field, how these career outcome expectations change over a HE graduate education and the reasons attributed to these changes. By characterizing student career expectations, HE educational

programs can better understand the interests of their students, inform students on realities in the field, and help students align their interests with a career.

BACKGROUND

Humanitarian Engineering Careers

HE practitioners and academics work in a diverse array of fields and institutions. 250 humanitarian-orientated engineers recently provided insight for students wanting to enter the HE field. They indicated they worked across all sectors of employment, including public, private, and social sectors (Mehta and Gorski 2016), and thus were employed in different organizational types, including consulting firms, social enterprises, non-government organizations, educational institutions, international development organizations, government agencies, corporate responsibility divisions, and more (Geiger et al. 2021). Further, within these career pathways, HE practitioners perform many different tasks, including designing and developing technology, designing sustainable systems, measuring progress towards SDGs, teaching, project management, environmental monitoring, and decommissioning facilities (Burleson et al. 2023).

Across these varying sectors, organizations, and tasks, HE practitioners often use interdisciplinary skill sets. For example, HE jobs often involve tackling complex modern-day engineering initiatives such as the United Nations Sustainable Development Goals (SDG) (U.N. 2013). Practitioners have emphasized the broad and multidisciplinary skills needed to tackle these initiatives. For example, an HE practitioner must utilize systems thinking with data-driven and evidence-based research approaches to unpack the challenges of reaching an SDG (Mehta and Gorski 2016). Adding to the need for creativity, other practitioners have emphasized the importance of practicing flexibility, multi-linguism, and empathy in HE work (Geiger et al. 2021). Further, HE practitioners need to work and communicate in interdisciplinary, collaborative teams (Mehta and Gorski 2016), and in doing so, carry reflexive, leadership, and cross-cultural collaboration skill sets (Burleson et al. 2023).

Career Outcome Expectations

To investigate HE students' expectations of the HE career, we will use social cognitive career theory (SCCT). SCCT has been used to predict behaviors in post-secondary engineering students (Brubaker et al. 2017; Lent et al. 2007). This theory posits that students' career interests are tied to a student's career outcome expectations. Career outcome expectations consist of social benefits (salary, prestige, power), self-satisfying benefits (pride, enjoyment, happiness), and physical benefits (stress, strength, pain) that one expects from a potential career. These expectations can be perceived as positive or negative and thus considered to be benefits and barriers to joining a particular field. SCCT proposes that a student's career interests are linked to their outcome expectations because students are drawn to careers where the perceived outcomes are personally satisfying (Lent et al. 2007). Further, students build these outcome expectations as they accumulate learning experiences, which encompass any interaction, course, program, or experience in which learning takes place. Within these learning experiences, student beliefs about the outcomes [i.e., esteem, satisfaction, salary] of completing specific tasks and careers are developed. By tracking student career outcome expectations, we can begin theorizing what is bringing students to the HE field and how an HE graduate education may be influencing those expectations.

Humanitarian Engineering Education

HE education values and prioritizes multi-disciplinary scholarship, especially by incorporating social science disciplines into traditional engineering and construction curricula. HE scholars have long highlighted the importance of multidisciplinary HE teams and acknowledged that understanding social and technical constraints is critical to any effective engineering solution (MacDonald et al. 2022). Indeed HE education programs often instruct on human-centered design, where understanding the needs and desires of the users are prioritized (Boy 2021). This perspective is particularly stressed when working with underserved or historically oppressed communities where engineering solutions must be considered in a complex social, political, economic, and environmental context (Kaminsky and Javernick-Will 2015). Because of cross-disciplinary values, HE degree programs, class projects, and clubs attract students across diverse interests and fields of study (Adams and Burgoyne 2017; Swan et al. 2014). Once enrolled, many HE programs train students to prioritize and critically analyze the societal impact of engineering (Smith et al. 2020). Thus, scholars have found that students involved in HE activities have a greater understanding of the global and societal context of engineering (Budny and Gradoville 2011) and report comparable perceived technical skills but higher perceived professional skills than that of their peers (Litchfield and Javernick-Will 2015). Together these studies show HE education has an increased emphasis on multidisciplinary training.

HE programs have been found to attract engineering students with an increased motivation to provide social good and to gain professional skills (Litchfield and Javernick-Will 2015 p. 201; Swan et al. 2014). Literature has captured HE students expressing that they want to be more than “just an engineer” and critiquing traditional engineers as “more like robots” than people (Niles et al. 2018). Common reasons engineers involved in Engineers Without Borders (EWB) did not identify with “being an engineer” were their enjoyment and participation in humanities courses and caring about social justice (Litchfield and Javernick-Will 2015). HE programs have also reported increased racial and gender diversity. In particular, females and underrepresented BIPOC students rank wanting to help people as a significant reason to pursue engineering (Barrington and Duffy 2007; Brubaker et al. 2017) and have stronger retention rates in undergraduate courses with humanitarian design projects (Adams and Burgoyne 2017). This scholarship indicates students may find peers with diverse backgrounds and motivations for social good in HE educational programs.

RESEARCH QUESTIONS

This research intends to connect and build from past research on the Humanitarian Engineering career, education programs, and decolonial shifts in the field. In particular, we will address the shortage of research on HE students' career expectations and interests and ask:

1. What are students' HE outcome expectations when they begin an HE graduate program?
2. How do these HE outcome expectations shift/change through the HE graduate program?

METHODS

To address these questions, we conducted longitudinal interviews with seven students, each enrolled in one of seven different graduate Humanitarian Engineering programs. Selected graduate programs had a HE graduate certificate within an MS program and/or a HE graduate degree. They had mission statements similar to “promoting integrated and participatory solutions to humanitarian development by educating globally responsible engineering students and

professionals to address the problems faced by developing communities worldwide” (the mission statement of the Mortenson Center in Global Engineering at the University of Colorado Boulder). Recruited students carried varying racial and ethnic identities, ages, nationalities, and previous experience in the HE field. Further, students were at different stages of their graduate education, including some who had just started the programs and others who had been enrolled before the first interview.

Using processes outlined in Institutional Review Board Protocol 21-0207, we recruited students through email advertisements circulated from program directors and professors to their respective HE cohorts. Students received incentives to partake in longitudinal interviews of 20 dollars per data collection experience. Recruited students carried varying racial and ethnic identities, ages, and nationalities.

Longitudinal interviews captured students' evolving HE career expectations in the HE field. To capture students' initial expectations of the field, all students were asked to describe the story of what led to their current career goals and enrolling in an HE graduate program. For the following three interviews, students were asked what aspects of a career were important to them, how their career goals had shifted, and what had influenced the shifts over the last semester. From these initial questions, students were probed to describe their expectations of the HE field in thick detail or within the style of ethnographic interviewing. Audio recordings were transcribed using Trint and imported into the qualitative coding software NVivo (Kofman 2023; Richards and Richards 2022).

Student interviews were deductively coded for *outcome expectations* of various fields and careers. We identified outcome expectations whenever students talked about attainments they believed came from a career. This included attainments that made them more interested in a particular field and those that made them less interested in the field. Interview segments were coded as *HE field outcome expectations* when students discussed an outcome they expected from a career that focused on the infrastructure and public service needs of marginalized communities. When students discussed what they expected from any other career or field, Interview segments were coded as *other career outcome expectations*. We found inductively collected subcodes of *outcome themes* for student HE field outcome expectations. The ‘HE field outcome expectations’ and the ‘other field outcome expectations’ were sub-coded to these *outcome themes*. For example, in the following quote, “Hopefully (in an HE job) you'd be expected to understand the community, (..) talk to people (...there is) more outward focus, (...) also listen to community activists.” This segment would be coded as a *HE field outcome expectation* and under the outcome theme of *Work with project stakeholders and affected community members*, as the student is discussing how in the HE career she expects to work with and listen to community members and activists. To find patterns in how student expectations changed throughout their HE pathway, we looked for changes across student interviews for mentions of various outcome themes. This strategy allowed us to look for changes in students' expectations of the HE field and non-HE fields.

RESULTS

First, we will present the fourteen themes of outcome expectations that we characterized for the HE field. In the following section, we will explore three career expectation patterns that these HE students move through during their HE education. For each pathway, student career expectation patterns will be illustrated using bar graphs. Dark blue bars indicate student career expectations during their initial interest in the field, and black bars indicate students' perspectives in their third

and most recent interviews. The difference between these bars can help illustrate how student perspectives may shift over an HE education.

HE Student's Initial Expectations of the Field

Table 1 presents the student's initial outcome expectations for the HE field by identified category, along with example quotes. This study found students portraying HE practitioners as tackling harmful people-affecting issues, valuing interdisciplinary thinking and collaboration, and bringing value through their increased access to materials, resources, and knowledge; and depict the work environment as being surrounded by individuals passionate for social good, critical and thoughtful in deciding how to enact social good, and who carry diverse gender, racial, and nationality identities. Further, they describe a HE practitioner's daily life to include listening to the needs of different stakeholders of an engineering project and community members affected by the project, enjoying global travel, and having difficulty separating one's work life from one's home life. They also indicate drawbacks, shown in italics in Table 1, describing hurdles to entering the field, a lower salary than other available careers, and difficulty maintaining a personal life and connecting to family due to travel. This impact, daily life, work environment, and drawbacks illustrate the imagined HE career of these students when they first entered an HE educational pathway.

Table 1: HE Outcome themes of student's initial interest in HE field

HE field Outcome Expectations	Number of students (out of 7) who mentioned expectation
Make progress on engineering issues that affect people/society	7
Enjoy traveling globally	7
Work with coworkers passionate to enact social good	7
Work with project stakeholders and affected community members	7
Receive low compensation	6
Value interdisciplinary thinking and collaboration	5
Work with diverse co-workers (nationality, gender, race)	5
Bring value to HE projects because of my (social and cultural capital)	4
Be in a self-critical and reflective field	4
<i>Be in a stressful environment with high rates of burnout</i>	5
<i>Have difficulty getting my first "HE job"</i>	4
<i>Have a strain on my personal life if I am traveling</i>	1

Career Expectation Pattern 1: Expectations of Humanitarian Engineering Versus Traditional, non-marginalized community-centered career options.

Some students carried expectations that HE jobs contained outcomes that were difficult to find in other professions; however, students changed their expectations throughout the program by perceiving these outcomes to also be available in non-HE jobs as well. Outcome expectations were

coded under this career expectation pattern if there was at least a 25% increase in students who perceived this outcome expectation to be available in non-HE careers by the 3rd interview. A 25% change served as the yardstick to indicate patterns across this study because of its ability to capture potentially substantial shifts in students' career outcome expectations, appropriate for the context of this qualitative exploratory study. This changing expectation pattern brought students to the HE field when students believed in the uniqueness of the HE field and pushed them to seek careers elsewhere when they began expecting other fields to provide the same desired outcomes. The following figure shows six outcome expectations that were initially seen as unique in the HE field, as illustrated by the dark bar being off-center towards the left of the y-axis.

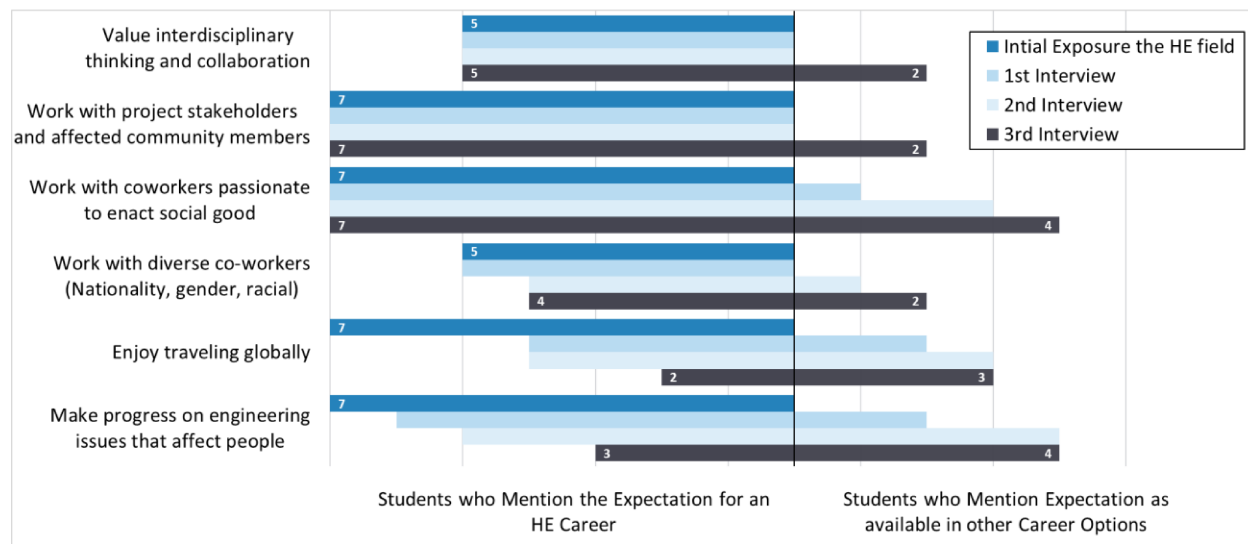


Figure 1: Changing Outcome Expectations for the Uniqueness of the HE Career

This career expectation pattern tells a story of students initially being drawn to HE as an avenue to address the issues they care about and to use tactics they find interesting and important. Here students describe struggling to find passion or interest in available careers before they were introduced to HE. This was especially true for students who started from another construction or engineering discipline career pathway. In particular, the HE career pathway became an avenue to working on purposeful, impactful projects and utilizing different disciplines in engineering design. Further, students spoke of difficulty finding other careers that had tasks including communicating with community partners and project stakeholders. In addition, the ability to travel to other countries was frequently mentioned as a positive benefit of HE. Students described struggling to find these spaces in more traditional engineering fields. In particular, students struggled to find peers in non-HE spaces with similar passions for social good or from diverse gender, nationality, or racial identities. The dark blue bars of the figure above shows the students who saw these expected outcomes of the HE career as a novelty compared to their other career options.

However, if we focus on the difference between the dark blue bars (initial exposure) and black bars (3rd interview) in the figure above, we can see that throughout interviews, some students began to see that combinations of these “exclusive” expectations could be found in other work environments. Namely, students began to see that traditional engineering firms were beginning to have work environments and project missions dedicated to social good and tackling issues harmfully affecting people today. Further, students increasingly discussed an interest in personal travel instead of traveling through work and an interest in traveling globally while working remotely for non-HE-orientated careers. A shift in expectations of the outcomes initially thought

to be exclusive of an HE career can be seen in the quote below. Here a student indicates how she was surprised by how much she enjoyed the work environment and mission of non-HE internship experiences.

One of (my projects) was with a local utility company looking at their climate change impact. I think being exposed to that project made me more open-minded (...) Whereas before (...) I didn't really think that I would enjoy working with a traditional company in the U.S.. But — I think I really like the partners that we have on the project at the utility, and I like working with big data,

The changing outcome expectations of non-HE jobs may affect student interest in the field. The student featured in the passage above discussed how she realized a non-HE career could have co-workers with similar passions for social good and tackling wicked problems such as climate change in later interviews. This realization pushed her to be open to career opportunities outside the HE field.

Career Expectation Pattern 2: Consistent Expectations of Strain of HE Jobs

We found four categories of expectations of a strain on working in the HE field that held constant over the four interviews. These are illustrated in the figure below. These outcome expectations were put in this career expectation pattern as they were negative expectations that students consistently carried for the HE field and did not expect in other career opportunities.

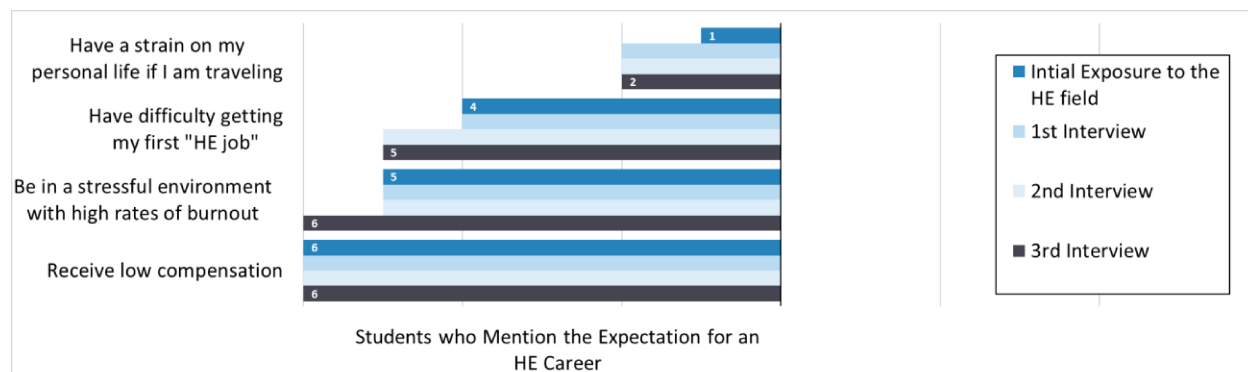


Figure 2: Consistent Expectation of Strain in HE Career,

In initial interviews, these students voiced the expectation that HE work abroad may make it difficult to have a family, the pathway to getting an HE job was unclear compared to other work opportunities, careers in HE make less money than other work opportunities, and HE careers may involve a difficult work-life balance. However, we anecdotally found these students also voiced an initial lack of concern about these expectations of the HE field. In other words, students were not prioritizing these expectations of an HE career and instead were prioritizing their perceived benefits of the field at their initial exposure. These issues remained stagnant, or students became more concerned about these outcomes as they proceeded through their graduate HE program. For instance, more students expressed concern about being away from their families. This concern was tied to an increasing desire to make a community, a desire to grow one's nuclear family, and a desire to be of service to one's relatives. Further, some students begin discussing increased concern over the perceived stressful work environment of an HE career and the fear of burnout. Some students in the initial interviews discussed experiencing loneliness, depression, and anxiety working in HE spaces, especially HE experiential projects. However, this became a concern for these students only later in their HE education. Some students also became more interested in

salary and, thus, disinterested in a career in the HE field due to the perceived lower salary compared to their other career options. This may involve realizing the potential and ease of benefits in other career opportunities or an increased concern for a perceived lack of salary and job benefits. Finally, most commonly, students became increasingly concerned about the perceived difficulty and confusion around finding an HE job. This occurred primarily when students were job hunting and felt underqualified for HE job requirements, feeling that HE jobs needed more networking than other job opportunities, or were simply confused about how to find an HE career.

Career Expectation Pattern 3: Changing Expectations of HE Sector

We found four categories of HE career outcome expectations that shifted over interviews. These shifts in outcome expectations may allude to changes in the sector. This career expectation pattern is illustrated in Figure 4 by the difference in the dark blue bars and black bars on the left side of the y-axis. Outcome expectations fell into this career expectation pattern when there was at least a 25% decrease in students who carried that expectation for the HE field over their HE education.

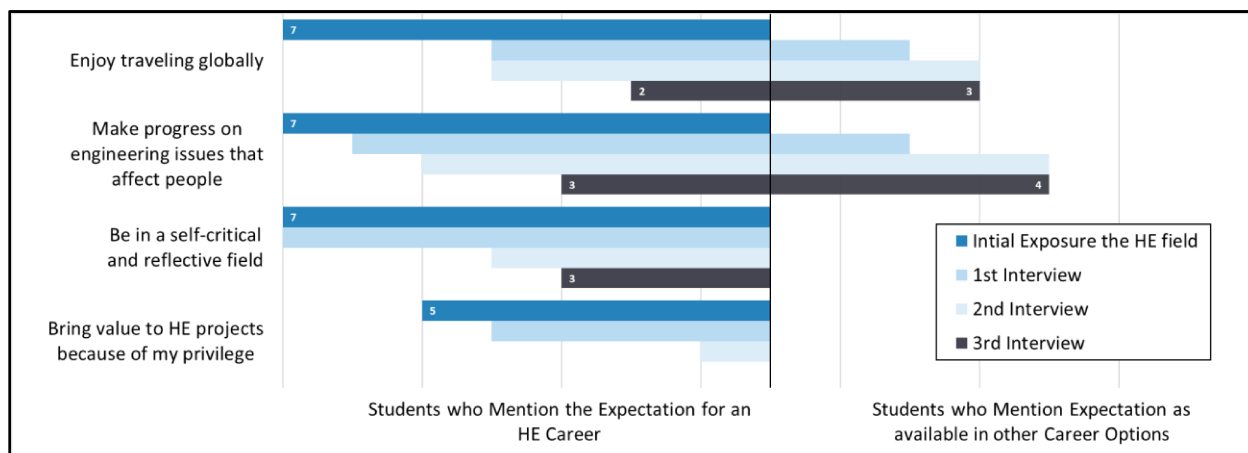


Figure 3: Changing Outcome Expectations for Realization of Entitlement Career Interest Path

As time went on, students began reflecting on the loss of an expectation of four outcome expectations in the HE field. First of all, students reflected on a disinterest in traveling for a HE career, and in particular, traveling in and out of marginalized communities. Some students discussed how in HE spaces, while there may still be opportunities to partake in travel, they worried it was of little benefit to marginalized communities or even risked causing harm to these communities. The lack of value and potential harm students saw from traveling lowered the self-satisfaction these students expected from the HE field. This sentiment can be illustrated in the following quote:

There's (...) an interesting program where they directly funnel donor money into (...) (building a pool of engineers within (various) countries(...) that sounds a lot better than "let's send a bunch of students to do kind of meaningless project work" (...) I just find it very difficult as a non-citizen (...) to sort of operate as an engineer there.

Secondly, students began to report frustration that HE practitioners are not being as self-critical and reflective as they hoped. This frustration can be seen in the following student's critique of a HE practitioner she was told to look up to. In the following passage, this student discusses how she thought the practitioner would be more critical about their actions and how they talked about their efforts.

Somebody was coming to speak, and my professors were like, “This is the quintessential (humanitarian) engineer” (...) her answers were weirdly flippant. (...),” and I was just so genuinely upset. I was like, “This is the quintessential (humanitarian) engineer? I don't want to be her.” and all my peers who I have wonderful critical conversations with were affirming her.

Some students also lost a belief in the value they brought to marginalized spaces through their privilege. Some students stopped participating in HE attempts where volunteers had exclusive access to resources such as grants (peace corp, senior projects) and began reflecting on their value in HE without these resources. Further, students started believing that they did not carry educational or technical knowledge that could benefit marginalized groups. One student discussed how they believed HE companies wanted to diversify their coworkers with people with lived experiences in the communities they were working.

LIMITATIONS

While the study aims to explore the evolving career expectations of students enrolled in various graduate HE programs, it has several limitations that impact its generalizability. Firstly, the sample size is limited, consisting of only seven students from different programs. Such a specific sample might not adequately represent the diversity of experiences and perspectives within the broader graduate HE landscape. Moreover, the participants were recruited through email advertisements and incentives, potentially biasing the sample towards those who are more motivated by financial rewards. The reliance on self-reported data through longitudinal interviews can introduce subjectivity and recall bias. Finally, future work should explore the underlying causes, such as learning experiences, that are influencing students' evolving expectations of the HE field and the implication of these changing expectations on the HE field.

CONCLUSION

This initial exploratory research contributes to the understanding of HE students' career expectations and changes over time. More specifically, this study has begun to characterize the expected outcomes that drive students' initial interest in the HE field and how a continued education within the field influences these expectations. We plan to continue the study by expanding the population to include 5-10 students from each HE program and further investigating how sectoral changes, such as decolonizing development, have influenced career outcome expectations, social justice self-efficacy, and transformational resistance. Practically, we hope this study provides HE education programs a more detailed understanding of their student's career expectations to be able to adjust programs and marketing material accordingly.

REFERENCES

- Adams, E. A., and M. B. Burgoyne. 2017. “Integrating Humanitarian Engineering Design Projects to Increase Retention of Underrepresented Minority Students and to Achieve Interpersonal Skill-Related Learning Outcomes.”
- Barrington, L., and J. Duffy. 2007. “Attracting Underrepresented Groups To Engineering With Service Learning.” *2007 Annu. Conf. Expo. Proc.*, 12.298.1-12.298.41. Honolulu, Hawaii: ASEE Conferences.
- Boy, G. A. 2021. “Design for flexibility [electronic resource] : a human systems integration approach / Guy André Boy.” Springer.

- Brubaker, E., M. Schar, and S. Sheppard. 2017. "Impact-Driven Engineering Students: Contributing Behavioral Correlates." *2017 ASEE Annu. Conf. Expo. Proc.*, 28473. Columbus, Ohio: ASEE Conferences.
- Budny, D., and R. T. Gradoville. 2011. "International Service Learning Design Projects: Educating Tomorrow's Engineers, Serving the Global Community, and Helping to Meet ABET Criterion." *Int. J. Serv. Learn. Eng. Humanit. Eng. Soc. Entrep.*, 6 (2): 98–117. <https://doi.org/10.24908/ijsle.v6i2.3548>.
- Burleson, G., J. Lajoie, C. Mabey, P. Sours, J. Ventrella, E. Peiffer, E. Stine, M. Stettler Kleine, L. MacDonald, J. Austin-Breneman, A. Javernick-Will, A. Winter, J. Lucena, D. Knight, S. Daniel, E. Thomas, C. A. Mattson, and I. Aranda. 2023. *Engineering Workforce Advancing Sustainable Development*. White Paper. ASME.
- Geiger, R., S. West, E. Peiffer, M. Stettler Kleine, and J. Lucena. 2021. *Mapping Engineering For Good Career Pathways: Examples From North America*. Engineering for Change, ASME, Colorado School of Mines.
- Kaminsky, J., and A. Javernick-Will. 2015. "Theorizing the Internal Social Sustainability of Sanitation Organizations." *J. Constr. Eng. Manag.*, 141 (2): 04014071. American Society of Civil Engineers. [https://doi.org/10.1061/\(ASCE\)CO.1943-7862.0000933](https://doi.org/10.1061/(ASCE)CO.1943-7862.0000933).
- Kofman, J. 2023. "Trint."
- Lent, R. W., D. Singley, H.-B. Sheu, J. A. Schmidt, and L. C. Schmidt. 2007. "Relation of Social-Cognitive Factors to Academic Satisfaction in Engineering Students." *J. Career Assess.*, 15 (1): 87–97. Thousand Oaks, CA: Sage Publications. <https://doi.org/10.1177/1069072706294518>.
- Litchfield, K., and A. Javernick-Will. 2015. "'I Am an Engineer AND': A Mixed Methods Study of Socially Engaged Engineers." *J. Eng. Educ. Wash. DC*, 104 (4): 393–416. Washington: Blackwell Publishing Ltd. <https://doi.org/10.1002/jee.20102>.
- MacDonald, L., E. Thomas, et al. 2022. "Aligning learning objectives and approaches in global engineering graduate programs: Review and recommendations by an interdisciplinary working group." *Dev. Eng.*, 7: 100095. <https://doi.org/10.1016/j.deveng.2022.100095>.
- Mehta, K., and I. Gorski. 2016. "Preparing engineers for careers in social innovation and sustainable development." *2016 IEEE Front. Educ. Conf. FIE*, 1–5.
- Niles, S., S. Contreras, S. Roudbari, J. Kaminsky, and J. Harrison. 2018. "Bringing in 'The Social': Resisting and Assisting Social Engagement in Engineering Education." *2018 World Eng. Educ. Forum - Glob. Eng. Deans Counc. WEEF-GEDC*, 1–6.
- Richards, L., and T. Richards. 2022. "Nvivo."
- Smith, J., A. L. H. Tran, and P. Compston. 2020. "Review of humanitarian action and development engineering education programmes." *Eur. J. Eng. Educ.*, 45 (2): 249–272. Taylor & Francis. <https://doi.org/10.1080/03043797.2019.1623179>.
- Swan, C., K. Paterson, and A. R. Bielefeldt. 2014. "Community Engagement in Engineering Education as a Way to Increase Inclusiveness." *Camb. Handb. Eng. Educ. Res.*, A. Johri and B. M. Olds, eds., 357–372. Cambridge: Cambridge University Press.
- U.N. 2013. "United Nations Millennium Development Goals." United Nations.