Preparing Engineering Students to Find the Best Job Fit: Starting Early with the Career Development Process

Dr. Cheryl Carrico, P.E., E4S, LLC

Cheryl Carrico is owner of E4S, LLC. E4S, LLC conducts external evaluations, engineering education research, and industry consulting. Her current research focus relates to STEM career pathways and conceptual understanding of core engineering principles.

Dr. Holly M. Matusovich, Virginia Tech

Dr. Holly Matusovich is the Associate Dean for Graduate and Professional Studies in the College of Engineering at Virginia Tech and a Professor in the Department of Engineering Education where she has also served in key leadership positions. Dr. Matusovich is recognized for her research and leadership related to graduate student mentoring and faculty development. She won the Hokie Supervisor Spotlight Award in 2014, received the College of Engineering Graduate Student Mentor Award in 2018, and was inducted into the Virginia Tech Academy of Faculty Leadership in 2020. Dr. Matusovich has been a PI/Co-PI on 19 funded research projects including the NSF CAREER Award, with her share of funding being nearly $3 million. She has co-authored 2 book chapters, 34 journal publications, and more than 80 conference papers. She is recognized for her research and teaching, including Dean's Awards for Outstanding New Faculty, Outstanding Teacher Award, and a Faculty Fellow. Dr. Matusovich has served the Educational Research and Methods (ERM) division of ASEE in many capacities over the past 10+ years including serving as Chair from 2017-2019. Dr. Matusovich is currently the Editor-in-Chief of the journal, Advances in Engineering Education and she serves on the ASEE committee for Scholarly Publications.

Dr. Sreyoshi Bhaduri, ThatStatsGirl

Dr. Sreyoshi Bhaduri is an Engineering Educator and People Research Scientist. Sreyoshi's expertise lies at the intersection of workforce development, AI and emerging technology, and engineering education. As a Research Scientist in the tech industry, Sreyoshi leverages AI for mixed-methods research on and for people at work, ensuring that organizations intentionally center the human experience. Sreyoshi has spoken at over 100+ global venues, addressing diverse audiences ranging from academics, NSF PIs, industry leaders, entrepreneurs, and professionals to students or high-schoolers starting out with Computer Sciences, helping them strategize and broaden participation, as well as explore, understand, and apply emerging technologies. Sreyoshi is committed to broadening participation among underrepresented minorities in engineering and serves as a Senator at the Society of Women Engineers. She is also part of the Advisory Board at the College of Engineering at Virginia Tech and serves as an Advisor to the leadership at Sisters in STEM. Sreyoshi frequently collaborates on several National Science Foundation projects in the engineering education realm, researching engineering career trajectories, student motivation, and learning. Sreyoshi has been recognized as a Fellow at the Academy for Teaching Excellence at Virginia Tech (VTGrATE) and a Fellow at the Global Perspectives Program (GPP) and was inducted to the Yale Bouchet Honor Society during her time at Virginia Tech. She has also been honored as an Engaged Advocate in 2022 and an Emerging Leader in Technology (New ELiTE) in 2021 by the Society of Women Engineers. Views expressed in this paper are the author's own, and do not necessarily reflect those of organizations she is associated with. Learn more about Sreyoshi's impact - www.ThatStatsGirl.com

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Abstract

In spite of the vast amount of literature that focuses on the need for significantly more science, technology, engineering, and mathematics (STEM) graduates, the importance of a student finding a good career fit, and what makes a student employable, little research exists on undergraduate engineering students' understanding of the process of how to find, qualify for, and secure a preferred first position after graduation (FPAG). Likewise, it is important for research to consider nuanced distinctions within STEM fields to assist research to practice transitions. Competition in securing jobs upon graduation is expected to continue, including for engineering positions. In fact, even in a market of high demand for STEM graduates, employers need candidates that display the skills, interests, and readiness to be successful employees.

A gap remains in understanding how prepared students feel and how they improve their preparedness to obtain their preferred FPAG, in particular within a specific discipline under the STEM domain. To explore this gap, we sought to answer these research questions:
1) What are students' self-rated perceptions of preparedness for their preferred FPAG and how do they compare to externally applied ratings?
2) What are common characteristics of preparedness levels?

Our research has important implications for all career decision-maker socializers. Our findings reveal that students may not be accurate with their self-assessment of preparedness for the job acquisition process. In fact, they overrated their preparedness in several cases. It is likely that students are overestimating their abilities because they lack an accurate understanding of what the career development process entails. We offer pragmatic suggestions for faculty and career counselors on how to support students with this career development process. These findings are also relevant to career development professionals as they advise entry level professionals on career advancement strategies.

Keywords: Undergraduate engineering; career preparedness; first position after graduation; job fit; student perceptions; STEM; career counseling; advising; job search; employer satisfaction

Introduction

According to the Bureau of Labor Statistics [1], chemical engineering jobs are projected to grow by 8% from 2016 to 2026. This projected growth is on par with many other engineering disciplines and is about the average for all occupations (including non-engineering). The number of chemical engineering graduates each year is growing by approximately the same rate [2]. Consequently, securing jobs upon graduation will remain competitive and thus we must prepare students as best we can for this process. Although research exists on predictors of undergraduate retention in engineering [3]; less is known about career readiness for those who stay in the major. The ability to predict who will retain the major and pursue an engineering career is complicated. Additionally, a factor in early career retention for engineering is a perceived fit with the job, indicating the importance of securing a preferred FPAG. This preparation must include the skills needed to *secure* a preferred job, not just the skills to perform a job, and it is precisely this skill set to secure a preferred FPAG that is missing among students. That is, many students lack the knowledge of the process to research and find preferred jobs and an adequate understanding of how to apply for, interview, and negotiate for a preferred job. Interestingly, but not surprisingly, these job search skills are linked to some of the same skills employers are looking for in new employees. Yet a survey of potential employers and final year engineering students in Pakistan found a perception gap: "as employers place more emphasis in hiring on skills like creativity, communication, interpersonal, decision making, and problem solving, engineering graduates perceive that their technical skills will play a major role in getting them jobs" [4].

Securing the first position after graduation (FPAG) represents an iterative process where students explore variables that will maximize their outcome expectations (or perceived benefits) for their career choice decisions. For purposes of this paper, we have included three constructs: career development, job search, and job acquisition. Career development is a process of learning about one's interests, opportunities, desired outcomes, and exploring possible careers available; career development is not stagnant and one's learning experiences continue to influence one's career development. Variables within career development include, but are not limited to, career discussions with others, internships, undergraduate research, and extra-curricular activities. The job search process includes the tasks of looking for a job (which may be preferred or not) and includes using resources such as a university's career development center, job boards, and networking. Similar, but different, is the job acquisition process. The job acquisition process includes job searches to find jobs to apply to, applying to the jobs (e.g., sending in resumes (tailored or otherwise), references, and activities such as answering application questions), and other steps such as interviews and job offer negotiations. Note that variables such as networking may be used for career development, job searches, and job acquisition and thus the context of networking (or any nuanced item) is important to understanding how students find, or attempt to find, a preferred FPAG.

Further, certain career-related experiences like internships can have an impact on student career development and the job search process. Maertz Jr, Stoeberl, and Marks researched the benefits of internships for students, employers, and schools [5]. They conclude the benefits for both the student and the employer are more than problem solving via experiential learning; benefits also include students' abilities to communicate their areas of interest (and employers' abilities to understand how students communicate their interests), interpersonal skills. and making valuable contacts through networking opportunities. Finally, Finch, Hamilton, Baldwin, and Zehner conducted a literature review and concluded that job acquisition strategies for, students (from a variety of backgrounds) should highlight both their problem-solving skills and "soft skills" as job specific functional skills are not as important to potential employers as originally thought [6]. "To be a successful job applicant as a new graduate, technical skills are important but ranked intermediate as compared to the other categories." [6, p. 697]. Advice for chemical engineering job seekers echoes this need for inter-personal and professional skills (such as networking, communication, etc.) in addition to technical skills. For example, an *IChemE blog* offered job hunting tips for chemical engineering graduates which included items such as knowing what you want jobwise, researching companies, tailoring your resume, knowing your strengths and weaknesses, and practice during mock interviews to be prepared for both the expected and unexpected interview questions [7]. In an article describing skills not directly taught in chemical engineering programs, Petruzzelli calls out how important networking is to secure a job and contends that most students do not realize this [8]. Employers are aware that the best job candidates are likely to be referred to them by word of mouth and it is a much easier method for employers to utilize to fill vacancies which frequently are not advertised [9].

Purpose

In spite of the literature that focuses on the need for STEM graduates, the importance of a student finding a good fit, and what makes a student "employable," little research exists on undergraduate engineering students' understanding of the process of how to find, qualify for, and secure a preferred first job after graduation. A gap remains in understanding how the prepared students feel and how they improve their preparedness to obtain their preferred FPAG, in particular within a specific discipline under the STEM domain.

To begin exploring this gap, we sought to answer the research questions:
1) What are students' self-rated perceptions of preparedness for their preferred FPAG and how do they compare to externally applied ratings?
2) What are common characteristics of preparedness levels?

Preparedness is important for both students seeking a FPAG and the employer as, we argue, a high level of preparedness can improve both the student's opportunities for a preferred FPAG resulting in a good fit and potentially increase employee retention and advancement in engineering.

Understanding Preparedness is key to helping students secure a preferred FPAG

Competition in securing jobs upon graduation is expected to continue, including for engineering positions. In fact, even in a market of high demand for STEM graduates, employers need candidates that display the skills, interests, and readiness to be successful employees. Despite a clear need for students to be prepared to secure jobs, much of the research regarding engineering undergraduates' preparation for jobs focuses on the skills needed to do the actual work on the job [10] or focuses on the college to career transition [11, 12]. Employability models often focus primarily on the student's content and disciplinary skills, workplace experience, and efficacy beliefs [13, 14], though the CareerEDGE model [15] adds career development learning and reflection and evaluation components. Preparedness to achieve a best job fit, we argue, requires an overall understanding of career options, skills needed on the job, and skills needed to search for and acquire a preferred job. Thus, understanding each component and studying their interactions is important if we are to help students realize and improve their preparedness to gain a preferred FPAG.

Career development is an important aspect of preparedness as it can set the stage in terms of students knowing what types of jobs exist, what type of skills are needed for those jobs, and possible alignment with their interests. Though research indicates the importance of having an interest in a preferred job, other factors may prevail for some students, e.g., cultural, lower socioeconomic status, or first-generation college students and may be due to a lack of career development preparation [16]. In addition, a lack of knowledge regarding possible jobs may contribute to a students' unsuccessful pursuit of an engineering job or choosing a job outside of their academic preparation area instead. Within engineering, studies focused on students' intentions of pursuing an engineering career or leaving the field indicate half or more of students have at least some reservation regarding pursuit of an engineering career [17, 18]. Reasons for not pursuing an engineering career include unexpected or negative experiences, such as during internships/co-ops or interaction with faculty. Other factors included not feeling prepared to pursue an engineering career, not gaining decision making assistance from those having expertise in engineering careers, job opportunities outside of engineering, and students' beliefs that their engineering education and problem-solving skills are valued outside of engineering professions.

Career compromise is another factor affecting some students, which is influenced by students' perception of their employability and their associated career related distress. Creed and Hughes determined that while compromise may be normal, low levels of career development strategies were associated with increased career distress [19]. However, increased career exploration was found to be associated with an increased ability of students to adjust their outcome goals via disengagement and reengagement [20], which may lead to preferred FPAGs. Bonaccio, Gauvin, and Reeve analyzed the relationship between different job search strategies and emotions for novice job seekers [21]. They found that students who recounted their experiences with emotions tended to be more haphazard with their job search strategies than those with emotion neutral recounts. Students with haphazard strategies, i.e. less process and criteria oriented, were more likely to apply for and accept jobs that did not meet their criteria. These research examples support the importance of career exploration and students' having a comprehensive career development strategy. However, which students explore careers haphazardly and which students have a structured approach may not be obvious to faculty or career support specialists wanting to help them.

In Gault, Redington, and Schlager, research on internships and career success and career skill preparation was grouped into four categories: communication, academic, leadership, and job acquisition skills [22]. Though their research provides valuable insight regarding career skill preparation, it does not include measures to investigate students' understanding of a more holistic process of exploring choices, gaining skills needed for the job, and acquiring the job. Within our study, analysis of data from Career Decision-Making Socializers (CDMS), people having an impact on a student's career choices, were reviewed for reasons given by CDMSs to encourage student participation in internships. Though reasons for internships covered the entire process of career development, job skills needed, and job acquisition (as defined within our methods section), CDMSs did not tend to speak of the entire process and did tend to focus on only one or two advantages of internships. It is also important to understand nuanced differences within the STEM fields, and even within different engineering disciplines, to assist counselors, advisors, and faculty with translating research to practice for their students [23].

Methods

Our study was driven by two research questions:

1) What are students' self-rated perceptions of preparedness for their preferred FPAG and how do they compare to externally applied ratings?

2) What are common characteristics of preparedness levels?

To answer our research questions, we qualitatively analyzed semi-structured interviews with five undergraduate chemical engineering students at two different universities. We situated our study in the Professional Pathways Model (PPM), which uses Sampson et al.'s Cognitive Information Processing Theory [24] as a lens for Eccles et al.'s Expectancy-Value Theory (EVT) of student achievement motivation [25]. EVT has now become Situated Expectancy Value Theory (SEVT) which keeps the core concepts of EVT but recognizes situations within context [26]. However, PPM preceded SEVT so we retain EVT terminology. The PPM provides a comprehensive view of the knowledge, values, and ability beliefs that students bring to bear in making career decisions. Specifically, the PPM provides a way to examine how career knowledge and self-knowledge develop and contribute to student preparedness for motivated career choices.

We conducted these semi-structured interviews as part of a larger national mixed-methods study focusing on professional engineering pathways of undergraduate engineering students [27]. In this analysis, we focused on chemical engineering students. Of importance - this research does not attempt to determine causes of preparedness variations or which characteristics may have more influence than others. Instead, this research highlights differences in students' levels of preparedness and knowledge of the overall process of exploring potential jobs and obtaining a preferred FPAG.

Participants.

We solicited interview participants by asking for volunteers during a survey that was distributed to six different universities as part of the quantitative phase of this study. Chemical engineering students from two of the participating universities indicated interest in volunteering for an interview; all were invited to participate in an interview, and five interviews were completed. Our data include the initial survey and the interviews of these five participants . Based on sample size, the findings are *not* intended to be generalizable across all students but rather to begin to highlight typical cases [28] of students' experiences and inform chemical engineering educators and career development professionals of variations of career preparedness, even within a single major course of study.

The participants' demographics were obtained from the survey and interview responses. The participant group included two female students and three male students; self-reported ethnicity included White/Middle Eastern (Laura), Asian/White (David), and White (Mark, Matt, and Elise); all had a GPA above 3.01 (B+ or higher); and only one (Elise) reported having a job offer by the point of the interview.

We found that students' self-assessment of preparedness was often overestimated and a few key characteristics separate levels of preparedness, however for this study we do not have data to compare students with significantly different GPAs and have held the major to Chemical Engineering in an effort to limit anticipated variation across and as a result of different engineering programs. The two schools where our participants were enrolled have similarities and differences, which helps to contribute to the transferability of our findings. Both are large public universities in the eastern region of the United States. Neither school requires engineering students to co-op, though one requires internships for mechanical engineering students. Pertinent characteristics include the information shown in Table 1 for the school, college of engineering (COE), and department of chemical engineering.

Table 1. School and Chemical Engineering Demographics

School Level					
School	**Carnegie Selectivity**	**Undergraduate enrollment**	**Undergraduate enrollment in COE**	**Percent women COE**	**Percent white COE**
ECOM	Selective	<25000	<2000	25% - 30%	40%-50%
ERES	More Selective	25000-30000	6001-8000	20% - 25%	50% - 60%
Chemical Engineering Level					
School	**Undergraduate Chemical Engineering Enrollment**		**Undergrad Chemical Engineering Females Students**		**Undergrad Chemical Engineering "White"**
ECOM	< 200		30% - 40%		40% - 50%
ERES	201 – 400		30% - 40%		50% - 70%

Data for Table 1 was retrieved from 2017 ASEE school profiles (http://profiles.asee.org) and placed into ranges for school anonymity.

Interview Protocol

Our interview questions fit into two major categories: 1) career development and skills perceived as necessary on the job (five questions) and 2) the skills needed to obtain a FPAG (four questions). Within each question were prompts to aid in obtaining context and rich descriptions of responses. Though the entire interview transcript was reviewed, several questions were particularly pertinent for this analysis.
Table 2 shows pertinent questions by category.

Table 2. Interview Questions Pertinent to This Analysis

Category	**Question(s)**

Career Development	I know you may not have thought very far past graduation, but if you can, what career options, or paths, do you believe are generally available to you, in particular, over the next 5 years?
	Follow-up: Are there any career paths you think are <u>not</u> available to you?
Job Skills	How do you think your knowledge and skills will influence your career plans?
	Follow-up: How did you develop this knowledge and these skills?
Job Acquisition Skills Perceptions of Preparedness	Regarding getting a job, what do you think will be the most meaningful aspect of your job search process?
	What knowledge, skills, and abilities do you believe to be most important in obtaining your first job; how does this knowledge and these skills and abilities interrelate?
	Considering everything we have just talked about, if you had to, how would you rate your preparedness with regard to post graduation career plans?

Analysis.

Our coding process had three stages. First, we categorized each statement into one of four overarching categories relating to the process of career development through obtaining a job. Next, we assessed each statement for level of preparedness. Finally, we compared the preparedness assessment results to identify salient characteristics across participants and categories.

During the first stage of the analysis, we coded the entire set of interview transcripts using the a priori categories of career development, job skills, job acquisition skills, and overall FPAG process knowledge. The categories of career development, job skills, and job acquisition skills emerged from our earlier work in 2016 with CDMS as a way to operationalize the process by which students learn about, prepare for, and obtain a FPAG [29]. The code "overall FPAG process knowledge" emerged from our data and was defined as the process of learning about careers, determining a preferred FPAG, and knowing how to obtain that preferred FPAG. The codebook is contained in Table 3.

Table 3: Codebook

Category	Definition	Example
Career Development	When students are exploring different types of jobs. The	"So, I think just by sharing my story and talking to people, there were lots of outlets. I talked to one of my co-workers, and

	process of determining their career interests.	they're like, 'oh my brother works at X, Y, and Z', and I'm like, 'oh no way? That's cool. What do they do there?' And they kind of explained the company, so I was able to determine if that sounds like something I like or something I don't like."
Job Skills	The knowledge, skills, and abilities (KSAs) that will be needed on the job. These can be different from the KSAs needed to acquire a job.	"I've found that having certain skills, qualifications, and experience doing things that future employers or people you're interning with are looking for, that's a major help and that's been a top focus of mine, accumulating these skills and experience that I think could benefit me in the future."
Job Acquisition Skills	The process of applying for, interviewing, getting an offer, and accepting an offer. Knowing how to search for a job; create / edit cover letters and resumes; interview; accept, decline, or negotiate offers.	"Yeah, awards, and also specifically the in-class projects I did, I would put a lot of effort into, and I was commended by the professor in a couple of cases. I was able to talk about how I worked with those in technical, project-based applications of those that could be applicable to the company that I was applying to."
Overall FPAG Process Knowledge	The knowledge of the entire job seeking process from career development, finding/applying for jobs, up to obtaining a job. This is the ahead of time *knowledge* that 'I need to do this.'	"I think I found the position through the job portal. I'm trying to ... If I remember correctly, I found it through the job portal in my university, where they post open positions. I found it through there and I applied. Then I kept it in mind when I found out that I wouldn't be getting it, so that I could apply again for the future."

During the second stage of analysis, we determined each participant's level of preparedness in two ways: 1) direct self-reported level of preparedness from the interview; and 2) research team ratings of preparedness based on evaluation of the transcripts. We defined preparedness as both the participant's level of overall FPAG process knowledge and degree to which they were acting on that knowledge. For our rating process, we analyzed the coded segments by participant and by code category to determine if the segments represented a high, medium, or low level of preparedness. Criteria to assess participants' overall FPAG process knowledge were developed as part of our code book. The totality of the participant's individual coded segments was used to determine an overall FPAG process knowledge for each participant.

In the final stage, we used the process of pattern making [30] to compare specific characteristics (reasons or actions) provided within the participants' coded segments with the participants' levels of preparedness. This allowed us to determine the salient characteristics that contributed to different levels of preparedness.

To ensure the quality of our analysis, we used a combination of expert review of the code definitions and interrater reliability checks [30]. During the process, the analyst provided the interrater (an analyst on the larger [e.g., 31, 32] project) with a set of codes and definitions, and the definitions were discussed for clarity. Next, a random sampling of transcript data was provided to the intercoder who coded them. Differences of coding were discussed, definitions tightened, and the process repeated until agreement of coded segments occurred.

Research Findings and Recommendations

Our research resulted in two main findings based on the rich and in-depth data obtained from the five student interviews. First, most students self-reported fairly high levels of preparedness. However, not all of the self-reported levels match the levels indicated through a systematic analysis of the student's words used during data collection. Second, our results showed distinct patterns in characteristics that contributed to a student's preparedness, though the details of the actions for becoming prepared may differ. We found that what separated those participants ranked as highly prepared from the others was their understanding that obtaining their diploma was insufficient to compete on the job market. More specifically, they realized which skills, classes, or resources they needed to achieve their FPAG and took action to acquire them.

1) Students' self-rated perceptions of preparedness for their preferred FPAG was not always comparable to externally applied ratings by the research team, with students often over-estimating their preparedness.

When asked to rate their preparedness with regard to their post-graduation career plans, all participants ranked themselves as "pretty prepared" or better. However, as shown in Table 4, in two of five cases (e.g., David and Matt) there was a discrepancy between the participant's self-reported level of preparedness and the research team's assessment of the participant's preparedness.

Table 4. Participant Preparedness

Participant / Area	Laura	Mark	David	Elise	Matt

Self-reported level of preparedness	"pretty prepared"	8 on a scale from 1 to 10	"7.5 maybe an 8" on a scale from 1 to 10	"80 or 90 percent"	"very well off"
Analyzed level of preparedness	high	high	low	high	medium
GPA (range)	3.71 or above (A or higher)	3.71 or above (A or higher)	3.31 - 3.7 (A-)	3.01 - 3.30 (B+)	3.31 - 3.7 (A-)

Typical examples of preparedness for those rated as High include clear decisions on the type of industry in which they wanted to work (food / brewing, pharmaceutical, and environmental) through their career development, seeking the expertise of others to aid in their process, experiential learning activities to improve their knowledge of careers and skills needed on the job, and knowledge of the skills they needed to obtain the job.

We rated Matt as Medium for possessing some of the same factors as those rated as high, but not all. For example, he had the most industry experience through his cooperative education and internships but had not decided on a career choice at the time of his interview. Additionally, he did not reference asking experts for assistance in the process when he discussed an obstacle encountered as part of the job acquisition process.

We rated David as Low because of an absence of actions characteristic of students who prepare themselves for their FPAG. He provided statements that he knew of resources from the career center but did not utilize them. Also, he was unable to articulate the reasoning behind his career choice or state any action he took to specifically align himself with the specific career choice that he hoped to obtain. Table 5 presents the shared characteristics of participants based on preparedness for their preferred FPAG. Criteria to assess participants' preparedness for process knowledge needed to secure preferred FPAG (e.g., Career Development, Job Skills, Job Acquisition Skills, and Overall FPAG Process Knowledge) were developed as part of our code book.

Table 5. Shared Characteristics of Participants based on Preparedness for their Preferred FPAG

Category	Preparedness: High	Preparedness: Medium	Preparedness: Low
Overall Characteristics	Exhibited all of: Career development knowledge or experience; knowledge of skills needed and how to obtain those skills; knowledge and action of how to acquire their FPAG. Exhibited an understanding of the overall process knowledge necessary to obtain their preferred FPAG.	May exhibit knowing what is needed to obtain their preferred FPAG but lack action. May exhibit some of the knowledge and actions needed to obtain their preferred FPAG.	An absence of actions throughout the interview and or exhibiting a lack of overall process knowledge.
Example Behaviors	Acted on opportunities such as internships/co-ops. Began the process early, including sophomore year. Asked questions of key socializers such as career counselors and faculty.	Knew that resume systems can be automated but does not change their approach in writing.	Knew of potential resources but chose not to use them. No clear decision on preferred FPAG.

2) High preparedness level among students was characterized by certain commonalities that differentiated them for those with low preparedness.

We identified common characteristics that contribute to students' preparedness levels and explored in greater detail differences between self-ratings and research team ratings. The participants who were evaluated as having high levels of preparedness shared certain characteristics that differentiated them from the participants receiving lower ratings. While the highly prepared participants did not all use the same approach for preparing for their FPAGs, they had the following commonalities: 1) they recognized the importance of starting the process early; 2) they recognized the importance of developing specific skills; and 3) they relied on resources to assist them. Examples of how they accomplished these items included receiving expert opinions on decisions, developing job acquisition skills, or acquiring internships.

Highly prepared participants started the job acquisition process early. Highly prepared participants typically began looking for opportunities prior to the end of their sophomore year. They stated that peers and professors encouraged them to start early and get experience contacting and communicating with potential employers by attending career fairs and other company or engineering-specific career events. Seeking internships, co-ops, and extracurricular opportunities at this stage aided their career development. As an example, Elise noted:

> I feel like [it] always changes. I always 'think out' one thing, and then you find out you go with a job, and it kind of takes you somewhere else. I think my main thing ... I'm pretty open to opportunities that may arise. I've just kind of dabbled in what I've gotten a little bit of experience with, and figured out what I liked and what I didn't. I just want to be in a role where I enjoy it, but I do well at it.

She explained how working in specific roles and industries helped her discover the appropriate career. She provides other statements relating to her preferences and how she decided on an FPAG that fit those and her job skills. In contrast, David, rated as low with regard to preparedness, did not adequately articulate his reasons for choosing his ideal job (brewery industry) and provided no statements related to seeking manufacturing related skills prior to the job search in his senior year. Yet he ranked himself "a 7.5, maybe an 8" in terms of preparedness.

Highly prepared participants recognized the importance of developing specific skills.
Participants ranked as highly prepared recognized that obtaining specific skills had increased their competitiveness with employers either at the temporary (intern / co-op) stage or FPAG stage. Mark wanted an environmental engineering FPAG and knew the job requirements. Although he did not complete an internship until his junior year, he had already joined a campus club putting up green walls and participated in other volunteer activities that aligned with those that would be sought after by a future employer. Laura wanted to work in pharmaceutical manufacturing and acquired specific skills through research work under a mentor professor that then enabled her to acquire an internship her junior year that she had been rejected from the previous summer. In addition to gaining skills via work experience, she went outside the prescribed chemical engineering curriculum to better prepare for her FPAG:

> I'm really happy about the chemical engineering education that I've gotten here at my school. The only downside is I wish there were a little bit more of elective choices. I know that for me, specifically, I've had to reach out to the mechanical engineering department several times to try out some of their electives, because my department doesn't offer a whole lot geared to different industries. Our mechanical department is a little more developed. Just, that's where I've found that I needed to go to fill any gaps. Yeah.

The highly prepared students spoke of how the skill sets they had acquired through the classroom, work, and volunteering aligned with the needs of their future employers. They saw these traits as a means to market themselves and stand out among other students competing for the same positions when it came to being interviewed. In stark contrast, David, rated as low for preparedness, failed to draw upon relevant extracurricular activities and an undergraduate research position with a professor to gain an internship or co-op; instead, he simply stated he had no related manufacturing experience. As a senior, he had not yet realized how to gain experience directly related to his desired FPAG. When asked what his expectation was of obtaining that particular FPAG, he replied "twenty-five percent."

Highly prepared participants relied on resources to assist them. Those rated as high and medium all made statements of taking advantage of resources to varying degrees. For example, Matt praised the opportunities available through the career fair for giving him an alternative to applying for jobs online and attributed advice given from a professor during his first year as influencing him to obtain an internship. Laura and Elise sought assistance from the career center, and Mark used informal networking to obtain his first internship. David, ranked as low, claimed that he was aware of career center resources, such as workshops on interviewing, but that he "just read the emails, never went to the workshops, but reading those emails and figuring out, 'oh, companies like hearing these things'." He finished this statement by admitting he had received a rejection email within seconds of ending a phone interview, adding "I could tell the tone of the interview changed when I said something stupid." He said he learned from his past mistakes to research a company more prior to speaking with representatives, but still made little attempt to utilize other available resources. In fact, he commented that his strength is in interviewing saying, "I am getting pretty good at incorporating questions about the person interviewing me into my interview. Making them feel more connected to me in that way." Yet, he had not received any secondary callbacks at the time he participated in this study, which he attributed to a lack of practice interviewing. He continued that he thought there "is always room to improve interviews." However, when asked how he could improve his interview skills, his response suggested he did not need external help, he just needed to interview more.

> Honestly, I really think you can go to mock interviews all you want, but I really don't think they help nearly as much as just actually interviewing with people. A lot of what I learned, and what I gained from the interview process, isn't necessarily a job. It's how to interview in general. So, I think really, in order to gain that practice I really just have to have other interviews.

Finally, networking, whether formally or happenstance, aided those rated as high. For example, networking provided Elise with greater information for career development when she reached out to engineering alumni to ask them what their day-to-day work experiences were like. Networking increased Laura's ability to communicate with recruiters because she started meeting with them during her freshman year and continued making contact through company sponsored on-campus events that provided her with future employment contacts. Mark gained his only internship through an informal "chance" conversation with a friend whose father was looking to hire an engineer; after talking with the friend's father he was offered an internship in his desired field of specialty. Having an awareness of these potential resources and taking advantage of them aided the preparedness of those students we ranked as high in preparedness.

Summary of Findings

Our findings reveal that students may not be accurate with their self-assessment of preparedness for the job acquisition process. In fact, they overrated their preparedness in several cases. It is likely that students are overestimating their abilities because they lack an accurate understanding of what the career development process entails. This is really no different than students who overestimate their preparedness for an exam or other assessment because they lack fundamental understanding of what knowledge and skills are required. This phenomenon is quite common in research on learning specifically related to metacognition [33].

Our analysis across the full data set shows that individuals associated with the university, and particularly faculty, can influence students' career pathways [33]. Our findings agree with work by Zondag and Brink, who examined the percentage of students who indicated different career resources (e.g., faculty, courses, internships, and career services) as beneficial in career choice processes [34]. In their longitudinal study, they found that faculty and their courses are critical sources of career information, ranking in the top percentile of resources cited by the students across all three data points (1995, 2004, and 2013). Interestingly, internships were slightly higher than college professors and courses during the first two survey points (rating a few points higher). However, internships ranked below the college professors and courses in the 2013 survey. Notably, the percentages of students using each of these resources also increased across the different years the survey was deployed [35].

Our findings also reveal a set of characteristics contributing to preparedness. Although all of the highly prepared participants did not follow the exact same processes, they did start early, identified gaps within their own skill sets, utilized resources to fill those gaps, and engaged in networking. Beginning the process early gave participants time to make decisions, acquire necessary skills to perform—and acquire—a job, and to implement a contingency plan if they encountered a setback, such as a company merger or getting rejected from an internship. Recalling that Bonaccio et al. found that novice job seekers with haphazard job search strategies were more inclined to accept a job offer even if the job did not meet some of the student's preferred criteria [21], our findings agree with theirs in that an increased level of preparedness or having a more criteria-driven strategy tends to result in not compromising when seeking a preferred job.

Implications for Engineering Educators, Career Development Professionals, and Industry

Consistent with our data, we believe these career conversations are important to have early and often to enable students to start thinking about and working toward finding a job earlier in the process. Students may think and hear that they should move through the "system" linearly—go to college, get a degree, and then get a job. However, they may not realize that they need to be thinking about getting a job concurrently with getting their degree because doing so could help them explore and experience different career options. One way to approach conversations about careers is to help students to "think backward" about the job acquisition process. This should be particularly meaningful within chemical engineering curricula where we teach students in our operations courses to think about the desired product and then what process is needed to yield that product. Similarly, students could think about what type of job they want and then what is needed to get that job.

Our paper contributes to the gap in literature to explore career preparedness, and future work is recommended to explore more deeply the experiences of and among individuals from diverse backgrounds to inform educators and career development professionals, in and beyond chemical engineering. Nonetheless, our research uncovered themes that indicate the following key implications for all career decision-maker socializers (Career decision-maker socializers include career counselors and faculty who are critical to helping students make decisions towards preparing for and landing their first position after graduation (FPAG)) in engineering.

Faculty can take a more active and intentional role in helping students become prepared for the job acquisition process, beginning in the first-year classrooms. Often career process and job acquisition are topics that are brought up in discussions with junior and senior level undergraduate students. Based on our findings, we recommend that faculty talk to students directly about careers, beginning right in the first year. This can happen in one-on-one conversations but equally importantly it can and should happen within individual courses and across curricula. Such conversations can help students build critical process knowledge. Taking class time for such conversations will indicate this as a priority to students, i.e., that this is something to which they should pay attention to and plan for. This recommendation further extends to career development professionals who provide resources, outreach, and assistance to entry level professionals.

Developing what is needed (skills, experiences, etc.) to successfully secure a FPAG can take years to accomplish; thus, students should begin thinking about their job and the process of obtaining the job as early as their first year. Likewise, as collaborated by Creed and Hughes [19], female students who work with career development professionals to develop strategies for their FPAG are less likely to experience career compromise and resulting distress. Faculty could also emphasize to students that they should take personal ownership of the job acquisition process because the students themselves are the only ones who can actually secure their own jobs and will live them out. While counselors who work with students, in particular within career services groups, have resources available to assist students with career exploration skills, based on our data, students may not understand the importance of those resources as part of the FPAG process.

Faculty must incorporate skill-building exercises not only related to technical problem solving, but also how to translate the engineering thought process into dialogue, such as that required in behavioral interviews. Research already recommends that faculty incorporate "real-world" activities and problems into classes [36] to promote learning by helping students borrow from learning strategies used outside of classrooms, such as while pursuing hobbies [37]. While such activities are often intended to promote the learning of technical content, they also offer opportunities to talk about specific jobs or the job acquisition process more broadly. As interviews become more behavioral based (e.g., sharing about your situation, what you do, and how it worked), faculty can help students understand how to link these activities with both the interview process and a reflective means to think about career interests. For example, assignments that allow students to break down their technical solutions using to STAR (Situation - Task - Action - Result) framework common in behavioral interviews can help students build skills to communicate their thought process behind problem-solving. It is also helpful for students to realize how reflecting on an activity in terms of its interest and importance to them can be beneficial to the career development process. Faculty can also be more proactive to help students appreciate the value of utilizing major resources such as career services to guide them through this type of reflection.

Finally, hosting speakers from industry is another way to promote conversations about careers. Fang et al found benefits to students participating in a seminar series of industry speakers [36], but even inviting a speaker or two across a traditional (non-seminar) class could be a way to actively promote conversations about careers.

Career development professionals can create research-backed student personas as tools to raise awareness of the process of applying for and securing preferred First Position After Graduation (FPAG). Framing career exploration as a way to potentially lessen anxiety, the need to "settle" for a job, and the total job application time (by focusing job applications) could be a way to increase student interest in seeking career counseling support. This awareness effort, however, would involve "marketing" the career services not only for the services available, but also for how they may help students and alumni beyond the job application and interviewing portion of the FPAG process. One possible way to conduct this marketing is to use our data to highlight the personas of our five participants, how their belief of preparedness as a novice job seeker is often overestimated and what being well prepared may include.

Another way is to compare and contrast a student with low preparedness with others such that the examples are not personal, but so that students may be able to see themselves within the personas. Though "getting a job" is important, helping students obtain a preferred FPAG is even more of value for possible persistence in engineering, for "fit", and thus for the student. The findings from this study can help career counselors help students to see the value of job exploration as part of the overall job acquisition process and being prepared to obtain a preferred FPAG.

Beyond universities, in industry, managers must realize that they play a critical role in onboarding new graduates and ensuring not only continued professional development but also an enhanced sense of belonging. Companies spend a great deal of money and resources hiring and developing new hires. It behooves them to also help those new hires believe they are a fit with the company and see themselves as remaining and advancing over the long-term. Onboarding professionals and Managers of early career professionals are in a unique position to help early career professionals (ECPs) understand the value of a professional development plan and process for continued career growth and enhanced sense of belonging [38]. The employee's previous experience in job acquisition will factor into this plan. For instance, ECPs who obtained a job without a thorough understanding or development of a job acquisition process and plan, may need extra guidance in considering their short- and long-term goals at a company. Employees want to move up, but do not always have a clear sense of what they are doing or where they may best fit within a company. Having managers work with ECPs on a career development plan and explicitly discussing the need to network, research, and see where there may be fits for their skills and how current skills fits are applicable to career progression is important; after all, more than technical skills are needed to grow a career. Further, developing a team culture that supports enhanced sense of belonging can be critical to ECPs, especially those from minoritized communities. Even for students who seem to have the insight to know it is not just the technical skills needed on a job, managers can help with reflecting upon how skills, interests, and aptitudes best fit with the company in looking at their career plan.

Closing Thoughts

Our research begins to explore characteristics contributing to preparedness for students to secure their First Position After Graduation (FPAG). As explained previously, this work *does not* intend to be generalizable across all students, disciplines, or universities. We hope that by highlighting a variation of experiences and preparedness level even among a small sample of undergraduate students, we will spur research interest on this topic. We anticipate that the challenges around career preparedness are *not* always unique to the Chemical Engineering discipline, and hypothesize that students in other branches of engineering will have shared experiences in addition to discipline-specific ones.

In addition, we anticipate student's lived experiences, backgrounds, and exposure to engineering careers to further exacerbate differences in preparedness levels. Whether supporting students or young professionals in the career development process, pro-actively helping students build their related skills is a step in the right direction towards them finding their best career fit - a win for the students, for educators, and also, industry.

Future work could address these points as well as the primary limitation of this study- the small sample size. This analysis has demonstrated value in understanding student preparedness for FPAG attainment and a future study could focus more directly on this aspect through a larger interview sample size and additional surveys. Future work could also consider the perspective of faculty, staff, and others to continue to elicit effective practices in bolstering FPAG preparedness.

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