

Barriers to Securing Industry Internships in Computing

Amanpreet Kapoor

Computer & Info. Science & Engineering
University of Florida, Gainesville, FL, USA 32611
kapooramanpreet@ufl.edu

Christina Gardner-McCune

Computer & Info. Science & Engineering
University of Florida, Gainesville, FL, USA 32611
gmccune@ufl.edu

ABSTRACT

Industry internships offer CS students an opportunity to explore computing disciplines, evaluate self-interests, understand professional expectations, and secure future employment. However, less than 60% of CS students pursue an internship before graduation. We have a limited knowledge of why students do not participate in industry internships and the impediments they face to secure an internship position. This paper presents findings from our multi-institutional study aimed at understanding the barriers CS students face to secure an industry internship. We discuss these barriers through the lens of agency from Bandura's Social Cognitive Theory and the Social Cognitive Career Theory. We surveyed 302 CS undergraduate students who did not intern across two universities in the United States and used thematic analysis on the open-ended survey responses. We found four themes: low self-efficacy, alternate priority, and application process challenges. These themes suggest that CS students who do not intern self-evaluate them as not qualified, are applying but not securing an internship position due to lack of preparation or reliance on coursework, lack the knowledge pertinent to the internship recruitment process, and are not applying for internship positions due to alternate priorities or less developed agentic resources. This paper contributes to the fields' growing knowledge of CS students professional development. This knowledge has the potential to develop strategic support programs to increase students' competitiveness to secure internships as well as full-time employment.

CCS CONCEPTS

• **Social and professional topics** → Professional topics • **Social and professional topics** → Computing education • **Social and professional topics** → Employment issues

KEYWORDS

Internship, Professional Development, Computer Science Education, Undergraduates, Career Preparation

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1 INTRODUCTION

Jobs in computing are projected to grow at 13% annually over the next decade in the United States [41]. This growth is widening the gap between the number of computing jobs available in the industry and CS graduates required to fill these jobs [42]. The rising enrollments in computing majors [10] have ameliorated the situation to a certain extent, but the demand for CS graduates is outpacing the number of enrolments in the computing majors. Moreover, it is a cause for concern that recent CS graduates might be underprepared for jobs in the industry as the underemployment rates for computing jobs held at 26% in 2018 [43]. This under preparation further exacerbates the existing gap between the supply and demand of potential computing hires. In lieu of this under-preparedness, employers have noted that recent CS graduates lack technical competence and professional skills for pertinent jobs in the industry [6,34]. One reason that the students lack these competencies is due to inadequate professional development during the 4+ years they spend in the computing degree programs. Studies have shown that less than 61% students of the graduating seniors in the United States pursue at least one internship before graduation [29], a key mechanism by which our students undergo professional development. These numbers are consistent with our sample which suggests that 57.5% of the graduating senior CS students pursue an internship [22]. While research suggests that internships play a crucial role in gaining authentic experiences through experiential learning [18], building skills [19,40], and gaining future employment [9,29,44,45], less is known about why some of our students never participate in internships.

In this paper, we focus on exploring the barriers that 302 CS undergraduate students face to secure an industry internship in the United States and answer the following research question: *What barriers do CS undergraduate students, who do not intern, encounter in securing an industry internship?* These barriers are explored through CS undergraduate students' experiences during the degree program, personal characteristics, and career preparation process. The findings from our study have the potential to develop targeted support programs to help our students for securing internships as well as increase CS students' competitiveness to secure full-time employment.

2 BACKGROUND

2.1 Existing Research in CS Undergraduate Professional Development

Research in professional development for CS undergraduate students has focused on the professional development of students through participation in capstone courses [33,37,39], co-curricular activities [16], project-based courses [14], local community-service projects [13], part-time or remote internships [31], student experiences in industry internships [22,40], or work-integrated learning programs developed through industry-academia partnerships [11,15,17,32]. This research includes Parker's study which found that software engineering capstone courses allowed CS students to explore CS career options [33]. In another study, Fryling et al. found that a department-scaffolded internship program at Siena College had a positive impact on CS students' retention [17]. Research on professional development through CS industry internships is limited, however. This research includes inquiries on understanding the role of internships in professional identity formation [23,26,38] or exploring students' experiences of participation in an internship [8,22,35,40]. However, there is a lack of research in the CS education literature that focuses on gaining insights into why our students are not participating in internships as well as the barriers they face to secure these internship positions.

2.2 Theoretical Framework

In this paper, our exploration into the characteristics of individuals who have not been able to obtain internships is rooted in agency as described by Bandura's Social Cognitive Theory [1] and Lent et al.'s Social Cognitive Career Theory [25] which builds on Bandura's theory. These theories identify the characteristics of agentic behavior and how they shape an individual's ability to set and pursue goals and achieve their career aspirations. We use these theories to code and interpret our qualitative data on students' internship seeking behaviors and success.

2.2.1 Self-efficacy and Agency - Bandura's Social Cognitive Theory

Self-efficacy is the belief that one has about their capacity for specific achievements, given domain-specific obstacles [2]. Self-efficacy beliefs determine how people feel, think, motivate themselves and behave. Contrary to self-efficacy which expresses an individual's perception, agency illustrates an individual's actual ability to deal with a complex task. Bandura's Social Cognitive Theory suggests that human agency has four core properties: intentionality, forethought, self-reactiveness, and self-reflectiveness [3]. Intentionality is an individual's intentional planning and strategies for achieving specific outcomes. Forethought includes the temporal extension of agency and lets an individual visualize futures through cognitive representations that further guide their prospective actions. Agency is not limited to planning and forethinking but also includes self-reactiveness. Self-reactiveness instantiates an agent to "construct appropriate courses of action" and "regulate" appropriate behaviors [3]. Last, self-reflectiveness lets an

individual examine their functioning meta-cognitively and make corrections accordingly for future actions. Bandura states that people who develop their competencies, self-regulatory skills, and enabling beliefs in their efficacy are more successful in realizing desired futures than those with less developed agentic resources [3].

We believe that securing an internship position (a desired future outcome) requires intentionality, high self-efficacy, and agency from a student. This agency further leads to the cognitive development of skills that are required to secure an internship. Demonstration of an individual's agency or agentic properties can be identified through proxies including students' behavior of applying for internship positions, preparation for job interviews, or students' agency to develop technical and professional skills that are sought by employers. Thus, students who are not securing internships may lack forethought, intentionality, or other agentic resources.

2.2.2 Social Cognitive Career Theory

Social Cognitive Career Theory (SCCT) models and explains the three primary mechanisms that promote career exploration and attainment [7]: self-efficacy, outcome expectations, and performance goals [25]. In particular, an individual's interest in career-relevant activities is directly related to their self-efficacy and outcome expectations. SCCT posits that in order for an individual to form a sense of efficacy and to acquire outcome expectations about their engagement in career-relevant activities, they need continued exposure, practice, and feedback on their performance in these activities. Such extended engagement enables individuals to refine their skills and helps them to develop personal performance standards and goals [25]. SCCT further suggests that for interests to develop, individuals must be exposed to the types of "direct, vicarious, and persuasive" experiences that can give rise to and reinforce efficacy beliefs and positive outcome expectations [25].

Thus, people are likely to form a lasting interest in activities when they view themselves as competent and when they expect that they will produce valued outcomes. Without such experiences, regardless of their level of skills, talent, and interest, SCCT suggests that individuals do not have the opportunity to form strong self-efficacy and positive outcome beliefs. As one might expect, individuals' interests in activities are unlikely to develop when individuals doubt their competence and expect negative outcomes. As a result, individuals who do not have the opportunity to reinforce their skills, experience impeded career exploration and attainment. Moreover, as individuals engage in the process of career exploration and skill development, they also encounter obstacles e.g., financial, cultural, systemic, or have varying levels of support from influential others [25]. Thus, personal agency is necessary to help individuals form performance goals that stretch the individual beyond their perceived abilities and that provide motivation to overcome common obstacles and barriers inherent in skill development, career exploration, and career attainment.

3 METHODS

3.1 Study Design

We designed a cross-sectional multi-institutional study based on a Concurrent Triangulation Design [12] to understand how CS students participate in internships and other professional development activities through a survey and semi-structured interviews. In this design, both qualitative and quantitative data are collected concurrently but are analyzed separately and then combined [12]. Our study was designed in Spring 2019 after a pilot study in Spring 2016 [20,22]. This study is multi-institutional and has a larger sample size (5.5x) compared to our pilot. For this paper, we focus our analysis on the qualitative survey data and report our findings on the barriers faced by 302 CS undergraduate students who did not pursue an internship. This qualitative data was not collected in our pilot study but was relevant for collection in this study based on the emergence of new research questions from our previous analysis [20–22]. We address the following research question in this paper: *What barriers do CS undergraduate students, who do not intern, encounter in securing an industry internship?*

3.2 Research Sites

The survey was conducted at two universities in the United States and focused on four-year CS programs targeting students across academic standing, gender, and cultural diversity. Site A, the University of Florida, is a large public research university in the Southeast and offers CS, Computer Engineering (CE), and Digital Arts and Sciences (DAS) majors through the CS department. The students can choose a major when they start college but can change it at any time. Site B, the Georgia Institute of Technology, is another large public research university in the Southeast which was chosen to compare the trends at two similar types of institution. At Site B, undergraduate students can choose to major in CS or Computational Media and can specialize in a self-selected CS sub-discipline. Admission to both sites is competitive and internships at both sites are not required for graduation.

3.3 Participant Recruitment

Survey participants were recruited from Site A’s CS1, CS2, software engineering, human-computer interaction, and operating system courses. The students in these courses were given 1% extra credit towards their final grade for participating based on pre-approval by the course instructors. Students from Site B were recruited from a CS seminar course. They were also offered 1% extra credit. We also offered gift cards to every 40th respondent at Site A and Site B if they chose to opt-out of extra-credit. Overall, 299 students participated for extra-credit and three for a chance to obtain a gift-card.

3.4 Participants

654 students responded to our survey and completed at least 5% (Total Response Rate: 44.0% at Site A and 18.4% at Site B). From these 654 students, the following were discarded: 51 students who completed less than 80%, four students who were graduate students enrolled in an undergraduate course, 13

students who completed the survey twice for two different courses (the submission with the maximum completion time was not discarded), 56 students who were not majoring/minoring in a CS discipline, and one student who did not specify whether they interned or not. Therefore, we were left with 529 students who completed more than 80% of the survey (Average Completion Rate=99.8%). Of these 529 students, 60.7% of the CS undergraduate students (n=321) reported that they never interned during their undergraduate studies or were not hired by an employer the summer following our study for an internship. Specifically, 62.3% of the 485 students at Site A (n=302) and 43.2% of the 44 students at Site B (n=19) did not intern. The remaining 208 students at the two institutions previously interned or were interning the summer following our study. These 208 students were also excluded as they are not relevant for answering our research question. Further, 19 of the 321 students who did not intern were excluded as they did not respond to the qualitative question on our survey. Thus, we were left with 302 CS undergraduate students who never participated in an industry internship and answered the pertinent questions in our survey.

Of these 302 students, 285 students were enrolled at Site A and 17 at Site B. 276 were full-time students, 22 were part-time, three were post-baccalaureate, and one an exchange student. The students comprised of: 207 CS majors, 65 CE majors, 10 DAS majors, 10 CS minors, nine CS double majors, and one unspecified major. The average age of respondents was 21.1 years (SD=4.1, Min=17, Max=43). The average GPA of respondents was 3.44 on a scale of 4.00 (SD=0.47, Min=1.40, Max=4.00). Other demographics are shown in Table 1 and Table 2.

Table 1: Academic Standing[†] & Gender Identity of Participants (N=302)

Academic Standing (Year) [†]						Gender		
1	2	3	4	5-6	Others*	M	F	Others**
43.1%	17.2%	23.2%	11.3%	2.6%	2.6%	73.8%	25.5%	0.7%
n=130	n=52	n=70	n=34	n=8	n=8	n=223	n=77	n=2

*Post-baccalaureate, transfer students, or pursuing a second bachelor’s.
**One student did not specify gender and one student identified them as agender.

Table 2: Racial/Ethnic Identity of Participants (N=302)

White	Asian	Hispanic or Latinx	African American	Others*
43.0%	29.5%	20.2%	5.6%	1.7%
n=130	n=89	n=61	n=17	n=5

*Multi-racial (1), Native Hawaiian (1), Middle Eastern (1), Arab (1), and Did not specify (1).

3.5 Data Collection

We gained consent from the Institutional Review Board at Site A for a multi-institutional online survey administered over Qualtrics. On average, the students completed the survey in 37.3 minutes. The survey consisted of 11 sections (maximum of 74 questions due to display logic): Consent, Institution and Extra-credit, Demographics, Professional Goals, Professional Identity,

[†] In the United States, students’ academic standing in an undergraduate degree program refers to the year they are in the degree program which corresponds to Year 1 (freshman), Year 2 (sophomore), Year 3 (junior), Year 4 (senior), and Year 5-6 (super-senior).

Industry, Degree Experience, Social Supports, Professional Development, Advice and Suggestions, and Documents and Follow-up. These 74 questions were of three types: 49 multiple-choice questions (MCQs), 10 short-response questions, and 15 open-ended responses. These questions were taken from three sources: our qualitative analysis of pilot study [20–22], NCWIT Student Experience of the Major Survey [30], and CRA Data Buddies Survey [46]. For this paper, we focused our analysis on one open-ended question from the Industry section and quantitative factors from the demographics section to describe the context. The open-ended question in the survey that we use for our analysis was: *Why haven't you interned so far?* and this question was displayed to students who selected that they had not interned previously or were not participating in an internship the summer following our study.

3.6 Qualitative Data Analysis

We analyzed student responses to our open-ended question using thematic analysis based on grounded theory [36] in Microsoft Excel. We started with the raw data and created codes inductively using words from participant responses. The first author created primary codes which were then clustered to form categories, and these categories formed the basis of our codebook. The categories were merged to form the themes and the authors discussed the themes in which there was a disagreement until a consensus was reached about the theme accuracy and reliability. Then the data were recoded. This was followed by a frequency analysis of responses within each theme. We counted unique participants when computing these frequencies, to avoid counting multiple responses from the same participant within any theme. Some participants' responses belonged to more than one theme and thus the percentages don't add up to 100%.

3.7 Author Positionality

Regarding the positioning of authors to internships, the first author pursued an internship during their CS graduate school and have worked for multiple years in the tech industry after graduation. The second author pursued four internships during their undergraduate and graduate CS program and is currently an Assistant Professor at Site A. Both authors believe that pursuing internships have value in gaining employment and to secure an internship, one needs to take active steps outside of coursework. This position might have influenced the qualitative coding process.

3.8 Industry Internships in the United States and Hiring Context

Students can apply for internship positions in various computing disciplines including software engineering, web development, user experience design, data science, and computer networks. These positions include co-op's, paid, and unpaid internships. The type of companies ranges from working at startups or local companies like Gainesville Regional Utilities (GRU) to established companies like Google and Amazon. The internship positions offered in these computing domains and company types are competitive and employers make hiring

decisions through an elaborate process. This process consists of screening candidates through the Applicant tracking system (ATS) which select candidates based on keywords in a resume, employee referrals, or manually selecting candidates after interactions at career fairs and company information sessions. Companies then have one or more interviews to assess a potential candidate's technical and professional skills. A majority of companies ask CS students technical questions related to computing of which the infamous programming interview questions are most prominent [5]. In these interviews, students are asked to either write programs on whiteboards or shared-screen text editors regarding data structures, algorithms, and system design [4,27,28]. Students are evaluated on problem-solving skills, thought processes, and the ability to derive correct solutions in a limited timeframe. Some universities require students to pursue an internship before graduation while others have no such requirement.

4 FINDINGS

Our research question focused on understanding why most students in our sample (59.9% of 533 students) are not participating in internships (RQ. *What barriers do CS undergraduate students, who do not intern, encounter in securing an industry internship?*). To answer this research question, we analyzed student responses to an open-ended question in the survey, *“Why haven't you interned so far?”*. We used thematic analysis and coded student responses into 434 primary codes, 70 unique codes, and 18 categories. Four themes emerged from these categories (see Table 3 and Figure 1).

Table 3. Themes for Barriers to Securing Internships (N=302)

Themes	Count (n)	Percentage
Low self-efficacy	149	49.3%
Actions	113	37.4%
Alternate priority	102	33.8%
Application process challenges	16	5.3%

4.1 Low self-efficacy

In this theme, 49.3% of the 302 CS undergraduate students who did not intern (n=149) described that they were either not applying for internships or were not securing applied positions due to properties related to self-efficacy. These properties fell into three broad categories: self-evaluation (n=85), academic status (n=71), and lack of confidence and fear (n=19).

Eighty-five students in the self-evaluation category gauged their technical competence and stated that they did not have the necessary skills, were incompetent, lacked skills they thought were sought by the industry professionals or lacked involvement in personal projects, technical interview challenges, or activities outside of coursework. Students also evaluated their competence by assessing if they had taken appropriate coursework such as *“Data Structures and Algorithms”* or if they have the necessary competencies for a specific internship position in a CS subdiscipline. Further, students who belonged to the academic status category, reported that were not applying or securing an internship because of their age, year the students were in their

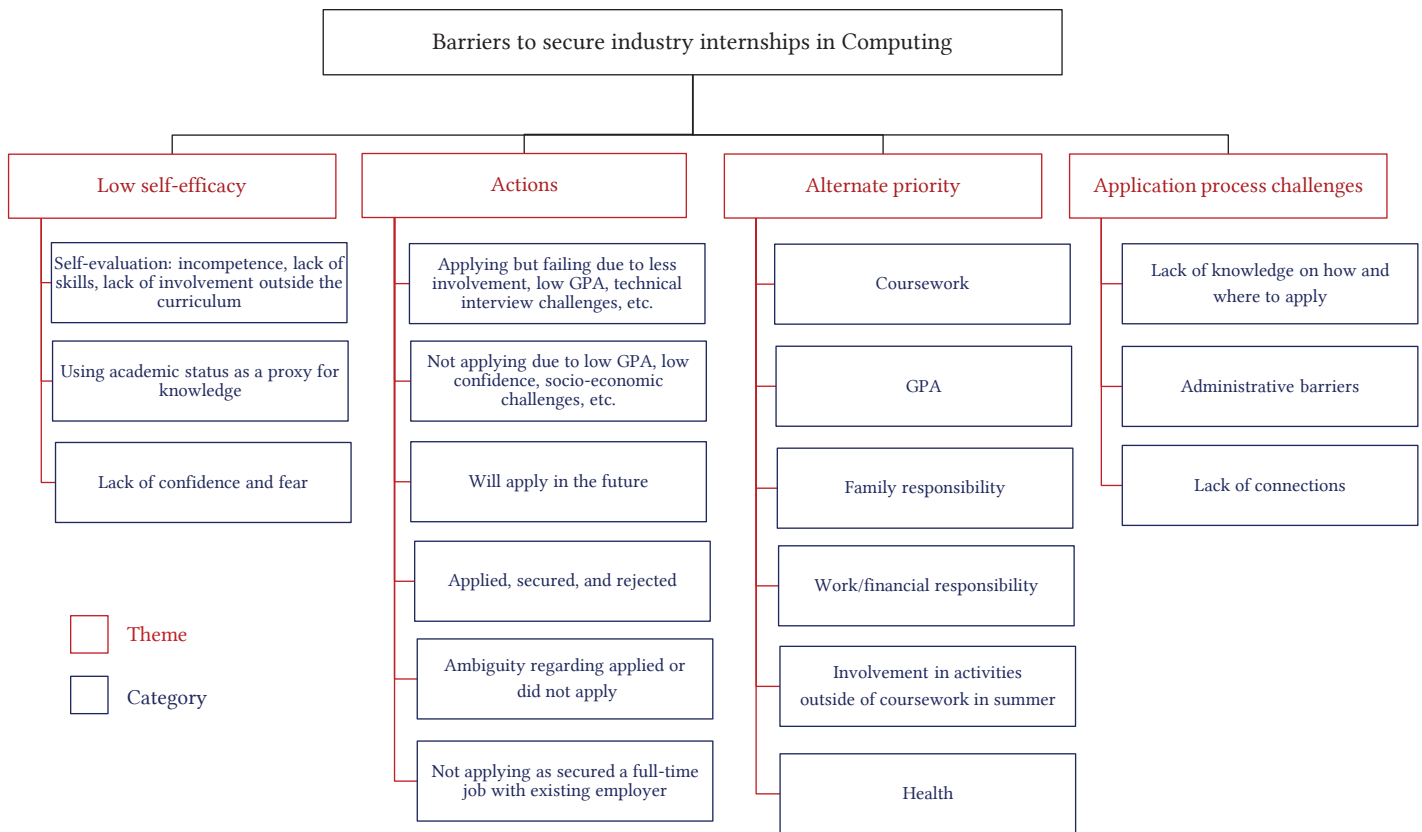


Figure 1: Thematic Analysis of Barriers to Securing Internships in Computing

degree program, student status in their program such as transfer or part-time student, or low GPA. Such students specified they were “freshman”, “sophomore”, “transfer student”, “young”, “new learner”, etc. These students used their academic status as a proxy for gauging their competence to secure an internship position. In addition, 19 students said that they lacked personal dispositional traits such as “confidence” or “motivation” to secure an internship or were “intimidated” to apply for a position. The quotes in this category were classified based on a participant’s feelings. The latter students were coded into lack of confidence and fear category. Some representative quotes from students belonging to this theme on why they did not intern include^{††}:

Self-evaluation: lack of experience and skills

“I haven’t interned yet because I’m too inexperienced to actually be competent at anything that I do, I’m still trying to transition my skills acquired in the classroom to the real world and currently I suck at that if I’m not given some form of direction or some type of hint at what I should do or how I should go about it.”
 - P301, Freshman Male

“I feel like I don’t have the skills required to intern, and my resume is not great.”
 - P204, Sophomore Male

“Not enough experience or intriguing personal projects; Lack of experience, work-wise and coding-wise.”
 - P376, Senior Male

“I’m not good enough to qualify.”
 - P341, Senior Female

Academic status: a proxy for gauging competence

“I am a freshman meaning recruiters don’t consider me a serious applicant until I’m a sophomore and have taken important classes like Data structures and computer organization.”
 - P156, Freshman Male

“I am not very far in the computer science major yet and I have not gone seeking out internships.”
 -P287, Sophomore Female

“I came from a community college where we learned our theoretical classes first, which is not desirable for most companies. Within a semester or two I will have the desired classes they want. I also lack technical experience via projects and club involvement.”
 - P162, Junior Female

Lack of confidence and fear

“I’m not sure how to begin finding an internship and I have a lot of anxiety and feel incompetent.”
 - P327, Junior Female

^{††} Participant quotes can belong to more than one theme.

“Anxiety about following through with smaller companies and a fear of rejection by putting myself out to a large number of internships.”
- P241, Senior Male

When we disaggregated the demographics of the students to understand if low self-efficacy was dependent on gender and if low self-efficacy was a concern only for CS students in preliminary years of their academic degree program, we found that on average females were higher in the low self-efficacy theme compared to males. 58% of the 77 females (n=45) who did not intern belonged to this theme compared to 46% of the 223 males (n=103). Specifically for the three categories, females were higher in each category: 35% of the 77 females (n=27) in self-evaluation compared to 26% of the 223 males (n=58); 31% of the 77 females (n=24) in academic status compared to 21% of the 223 males (n=46); and 8% of the 77 females (n=6) in confidence and fear compared to 6% of the 223 males (n=13).

While the freshmen who did not intern were most prominent in our sample in the self-efficacy theme (67.7% of 130, n=88), it is a cause of concern that a large number of sophomores (32.7% of 52, n=17), juniors (37.1% of 70, n=26), and seniors (29.4% of 34, n=10) who did not intern also had low self-efficacy.

4.2 Actions

Within this theme, 37.4% of the 302 CS undergraduate students who did not intern (n=113) described their actions to secure internship positions in six broad categories: applied but failed, did not apply, will apply in future, ambiguity on intent to apply, applied-secured-and-declined, and not applying because of secured full-time employment.

Of the 113 students, 41.6% described that they applied and did not succeed (n=47). Students who applied but failed to secure a position attributed their failure to lack of involvement outside of classroom in extra-curricular activities, low confidence, low GPA, less experience when compared to peers, and challenges related to coding they faced during the technical interview process. In contrast, 27.4% of the 113 students (n=31) reported explicitly that they were not applying because of low confidence, low GPA, focus on coursework and alternate responsibilities like work, family, or other socio-economic challenges discussed in Section 4.3. Further, 15.9% of the 113 students (n=18) stated that they were working on building skills and will apply in the future and 11.5% had ambiguous responses regarding whether or not they were applying for internships (n=13). In the latter category, a student responded by stating that they *“have not had an opportunity”*. In addition, 4.4% of these 113 students who did not intern (n=5) received an offer but declined an internship position due to low offered stipend, shifting priorities like starting their own company, or stating that the offered position was not related to computing. Last, two students did not apply for internships as they had secured pathways to full-time employment through their part-time work and planned to join their part-time employer after graduating.

Equal proportions of males and females were not applying for internships in our sample. Representative quotes from students belonging to this theme on why they did not intern include:

Applied but failed

Barriers in this category: Lack of involvement outside of classroom in extra-curricular activities, low confidence, low GPA, and technical interview challenges

“Recruiters that I have talked to have said to work on side projects. Companies that I have applied online to have all rejected my application.”
- P250, Sophomore Male

“The internship process is difficult. I applied and interviewed with multiple companies but I didn't do great on the technical interview side because I didn't take Data Structures course yet, although I taught myself some Data Structures it didn't help that much due to my lack of deep understanding.”
-P673, Junior Male

“Because they are others out there with better experience for the internships that I am trying to apply for. I applied to over 15 internship opportunities but did not get beyond the first line in all of them.”
- P320, Senior Male

“No offered yet thus far. I have only participated in one career showcase [career fair] and my current GPA is not pleasing.”
- P401, Year 5-6 Female

Did not apply

Barriers in this category: coursework, low GPA, low confidence, socio-economic challenges like finance and family

“I have not actively searched for an internship yet. I also do not feel I am ready for one yet.”
-P167, Freshman Female

“Haven't applied to many big companies that hire a lot of people. Also have been busy taking classes.”
- P177, Junior Female

“I haven't applied, I had a job to support my living and school expenses and leaving for an internship would have been too much strain on me. I support myself, so I couldn't lean on my parents financials.”
-P183, Senior Male

Will apply in future

“I had to take classes, and thus have no time to allocate for one as of now. In addition, I am trying to spend my freshman and sophomore years building experience. I plan on getting an internship after my Junior year when I have solidified my professional and technical experience.”
- P344, Sophomore Female

Applied, secured, and declined

Barriers in this category: financial constraints and alternate interests

“I declined my internships because I want to work on my own startup.”
- P630, Sophomore Male

“I am a non-traditional student with a family and cannot afford to take an internship when I instead need long-term employment. I wanted to focus on my school and graduate quickly so that I could

support my family. I actually interviewed for and was accepted for a Summer 2019 internship, but I could not afford to travel to Tampa and support my family with the offered compensation.”

- P600, Senior Female

4.3 Alternate priority

In this theme, 33.8% of the 302 CS undergraduate students (n=102) described they had not interned as they were focusing on coursework or improving their GPA (n=67), managing responsibilities revolving around work or family (n=26), or were involved in other activities over summer including study abroad (n=6), research (n=4), relaxation (n=2), startup (n=1), and personal project (n=1). The students who focused on coursework or improving their GPA wanted to build technical and professional competencies through curriculum, planned to graduate early, or had a hard time to manage coursework and extra-curricular activities. In addition, two students described that they did not intern because of medical conditions or health problems. Students also explained they had difficulties in managing time for multiple activities or wanted to focus on coursework during summer for graduating early. Some representative quotes in this theme included,

Focus on coursework and GPA

“I have been busy trying to keep my grades up for all of my classes, and I have found I am having difficulty with some; I am afraid that an extra workload in the form of an internship would bring my GPA to a dangerous low.”

- P243 Freshman Female

“I wanted to get further along with my courses and leave my internship for my last semester, this would allow me to hopefully transition into a job easier.”

- P364, Junior Male

Family, work, and financial responsibilities

“I haven't had the time since I have a job and classes, and I don't think I'm far enough into the major to be able to take on an internship.”

- P654, Sophomore Female

“I have a full-time job, taking CS one or two courses at a time to be able to balance. I've also been moving for my job.”

- P563 Junior Female

“Classes consume a lot of my time, my family's financial situation is also dire, and I more or less don't have the money to pay for housing elsewhere.”

- P397, Junior Male

“Due to financial issues, I have had to study and work at the same time and have not had as much time to reach out for internships.”

- P248, Senior Male

Involvement in activities over summer: study abroad, research, extracurricular activities like projects, etc.

“I am still in my first year of college and opted to take summer classes and do on Campus research my first summer to learn more before applying to jobs.”

- P221 Freshman Male

“I have not looked to obtain one yet. I have studied abroad instead.”

- P275 Sophomore Male

“I did not get a lot out of the Career Development Workshop/Career Showcase [career fair] this year and I am studying abroad in Hong Kong this summer instead.”

- P409 Sophomore Female

“I have not had the time as I've been busying myself with extracurriculars that I have used to enjoy my college experience.”

- P434 Junior Female

Health concerns

“For a few years it was lack of experience. In recent years I've felt more qualified, but I've dealt with a lot of health problems, and taking care of my health consumes a lot of free time that should be allocated to professional development.”

- P231, Senior Male

We also observed in this theme that females were more likely to be focused on coursework (29.9% of 77 females, n=23) when compared to males (19.3% of 223 males, n=43), while males were more likely to manage responsibilities revolving around work or family with coursework (9.9% of 223 males, n=22) when compared to females (5.2% of 77 females, n=4).

4.4 Application process challenges

5.3% of the 302 CS undergraduate students who did not intern (n=16) described that they had limited knowledge of how and where to apply for internship positions, lacked connections to apply for internships, or had visa restrictions that hindered them from participating in internships. Survey respondents like, P465, a male freshman who doesn't “know where to find internship opportunities” or P541, a male freshman who did not intern “mainly due to a lack of connections” fell in this theme. Other representative quotes of students belonging to this theme on why they did not intern include,

Lack of knowledge on how and where to apply

“I am having difficulties with my academics and do not know how to find one.”

- P246, Freshman Male

“I find it hard to find a company that will give me an internship in something I am interested in such as cybersecurity.”

- P591 Sophomore Male

“Haven't had relevant coursework or found employers willing to take interns with less than the usual required classes.”

- P284 Junior Male

Administrative barriers

“I have not interned so far because my status with the United States does not allow me to obtain a job.”

- P129 Freshman Female

Thus, we found that the barriers faced by students who do not intern include low self-efficacy to apply or secure an internship position, less agency to apply for internship positions, focus on alternate priority including coursework, family/work/financial responsibilities, or challenges related to the application process.

5 DISCUSSION AND CONCLUSION

Our paper contributes to the CS Education literature an understanding of the barriers that hinder CS undergraduate students' ability to secure industry internships. Four themes emerged related to these barriers: Low self-efficacy, Actions, Alternate priority, and Application process challenges. We found that a majority of students who do not intern had low self-efficacy and they evaluated themselves as incompetent for securing an internship due to lack of technical skills, relevant experiences, or where they were in the degree program. There is a possibility that the students' evaluation of themselves as lacking technical skills is erroneous and based on misconceptions given that some students stated in the survey that companies do not hire interns until junior year or companies require a high GPA from potential interns. These conceptions are not true given that our analysis from the same dataset as used in this paper has shown that 20% of the freshman and 45% of the sophomores pursue an internship [24]. Further, we have also found that there is no statistically significant difference in the GPA of students who intern and those who do not intern and students who had less than a 3.0 GPA on a 4.0 scale also secured internships at top tech companies in the United States [24], thus contradicting these students' conceptions.

Further, CS undergraduate students also felt incompetent due to their academic status, which included the time they spent in the degree program or their experience in computing. They described lower confidence as well as fear of rejection which hindered them from even applying for positions. According to the Social Cognitive Career Theory (SCCT), these students lacked the necessary agency to form performance goals [25]. This performance goal of securing an industry internship is necessary to stretch a student's perceived ability and for attaining motivation to overcome obstacles that include applying to various companies for intern positions or preparing for the interviews.

The students who did not intern also had alternate priorities including coursework or work/family responsibilities that hindered their ability to secure or apply for an internship position. SCCT suggests that during the process of career exploration and skill development, students may face financial, cultural, or systematic obstacles or have varying levels of support from influential others. These obstacles may subsume students' agency thereby hindering the formation of performance goals that stretch the individual beyond their perceived abilities [25]. In accordance with SCCT, we observed in our data that some students may not adequately harness the process of skill development, experiential learning, and career exploration due to financial constraints, administrative constraints such as visas, academic constraints such as maintaining a GPA, social constraints including family responsibilities, psychological constraints such as low self-efficacy, and recruitment-process constraints which includes technical interview challenges or involvement in projects and extra-curricular activities. These constraints suggest that in addition to the course load in CS undergraduate curriculums, the

industry expects student involvement outside the curriculum in terms of professional development and skill-building. Moreover, our students may face several other constraints outside of their academic life such as financial hardships that further exacerbate their ability for securing an internship. Leveraging financial capital to minimize these constraints by developing support programs for skill development and career exploration especially for such students might increase their competitiveness for joining the workforce or for securing an internship. Further, incorporating elements from other professional activities within the CS coursework can also reduce the burden on our students, especially for those students who do not attend informal activities such as clubs, thus increasing their ability for securing internships.

With regard to Bandura's properties for human agency: intentionality, forethought, self-reactiveness, and self-reflectiveness [3], the students who did not intern stated that they were not applying for internship positions, not preparing for securing internships as they had alternate priorities, and felt academically incompetent due to their self-evaluation or where they were in their degree program. While some students were applying and not securing internships, others were not intentional in their approaches for securing internships, lacking the necessary forethought needed to secure an internship. Some students also relied on coursework or their high GPA for securing an internship not knowing that active preparation is required outside the curriculum to secure a position. Students who are not applying for internships are losing an opportunity to improve professional and technical skills sought by the industry and for subsequently regulating their behavior to gain professional competence. Thus, such students lack agentic resources necessary to thrive through the industry recruitment process.

To conclude, students who did not intern were either applying and not securing an internship or lacked agentic resources that hindered their ability to secure internships. For the former students, we suggest the departments develop programs for improving technical competence and honing professional skills, while for the latter group, departments need to introduce programs for improving self-efficacy or for developing students' confidence. Without such support programs, SCCT suggests that regardless of a student's level of skills, talent, and interest, individuals will not have an opportunity to form strong self-efficacy and positive outcome beliefs [25]. Further, this hindrance to the students' career exploration and attainment process can lead them to doubt their competence or later join the workforce after graduation with an underprepared skillset. How will we satisfy the demand for computing graduates in such a scenario?

6 RECOMMENDATIONS

We highly recommend that departments develop specific professional development programs targeting students who have work/family responsibilities as well as find mechanisms for better dissemination of professional development opportunities given that students may not be taking advantage of these

opportunities and have misconceptions about the industry recruitment process. In addition, we suggest instructors and educators incorporate authentic skills required from the industry recruitment process within the curriculum so that all students can balance coursework with professional development and gain competencies in these skills. An example could be to use GitHub [47] for submitting projects so that students can show their portfolio to recruiters or using online code judges in Data Structures and Algorithms course where students can practice the implementation of various data structures for technical interviews. This is necessary as CS students who have responsibilities outside of the classroom such as work have limited opportunities for participation in extra-curricular at the university. We also suggest the instructors and departments to encourage students to pursue internships and disseminate the importance of pursuing internships. Finally, we encourage departments to assist student organizations and other professional development avenues which provide students an opportunity for career exploration and developing technical or professional skills.

7 LIMITATIONS

The findings presented in this paper represent a snapshot of the internship experiences taken from a sample of CS students at two US-based public universities. Our sample at Site B was relatively smaller than Site A and thus there is a higher likelihood of non-response bias at Site B. We collaborated with one course instructor for extra-credit at Site B. In the future, we would like to collaborate with more instructors for offering extra-credit, given the response rates were higher for extra-credit than for random gift cards. We also had a lower sample of certain groups such as Females or African Americans, but such samples were proportional to the respective proportions at the individual universities.

Further, the number of students at Site B (57%) who interned were higher than those at Site A (38%). The number of students at Site B who interned may not be representative of the population of students enrolled at Site B given the small sample and should be interpreted with caution. Larger sample size is required to understand the percentage of students who intern at Site B. However, the internships pursued by the students at both universities were actual real-world industry internships rather than interventions designed by academic-industry collaborations. Thus, student experiences in the real world strengthen external validity and our findings should generalize to CS undergraduate students who apply for internships in the industry in the United States.

Our findings may not generalize to experiences of CS students in other countries or other settings given the differences in the cultural context. In addition, our findings may not generalize to other schools that make internships mandatory for students before graduation. We provide a description of the two research sites and leave it up to the readers to make appropriate inferences of our findings at similar types of institutions. Finally, we attempt to address the validity of our qualitative inquiry through the transparency of our research

process, using participants' quotes, as well as recognizing the researchers' positionality.

8 FUTURE WORK

In the future, we would present a deeper analysis of the qualitative data by including the interview data. Also, we would analyze our data using Generalized Linear Modeling (Logistic Regression), to understand which of the factors contribute more to help our students to secure an industry internship. Finally, we have also collected resumes in the Documents section of our survey and analysis of the resumes might help us in identifying how our students are presenting themselves to the recruiters/industry professionals for securing an internship position. This latter document analysis might help us in gaining insights about the extent to which students lack agentic resources for the minimal requirements to secure an internship.

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