Understanding CS Undergraduate Students' Professional Development through the Lens of Internship Experiences

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

Professional development is critical for preparing undergraduate CS students for their future careers. Industry internships offer students pathways for professional development. However, little is empirically known about the impact industry-based internships have on CS students' career paths as well as the effectiveness of CS degree programs in preparing students for these professional development opportunities. In this paper, we present a thematic analysis of open-ended survey responses of 40 CS undergraduate students in the US who participated in an internship. This study aimed to understand the impact that professional internships have on: CS students' career goals, students' perceptions of the gaps between academia and industry, and students' strategies for professional success. We found four themes that describe the impact of internships on CS students. Internships (1) strengthened students' commitment to CS degrees and careers; (2) encouraged exploration of CS careers and industries; (3) promoted personal/professional growth; and (4) developed awareness of professional expectations. We also analyzed students' perception of the curriculum's effectiveness and found that students were strategically working to improve their technical skills outside of coursework to secure employment. These findings have the potential to retain students in computing and reduce the gaps between academia and industry, thereby increasing CS students' competitiveness in the workforce.

KEYWORDS

Internship; Professional development; Curricula improvement; Computing careers; Industry; Retention

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1 INTRODUCTION

The US Bureau of Labor Statistics projects that by 2020 there will be 1.4 million computer science (CS) related jobs available and 400,000 CS graduates with the skills to apply for those jobs [5]. In addition, CS jobs are projected to grow at 13% over the next decade [12]. While academic institutions are working to keep up with surging enrollments to educate students to address the increasing industry demand [3], 26% of the recent CS major graduates are underemployed in the United States according to a 2018 report by the Federal Reserve Bank of New York [26]. This suggests that current CS graduates may be underprepared to secure computing jobs, thus exacerbating the current challenge the US educational system is facing in preparing enough CS students to satisfy this demand. In addition, employers report that CS graduates often lack technical abilities, personal skills, and professional qualities [2, 22, 23].

As academic institutions, our role is to create pathways for career preparation through our degree programs to help students gain entry into computing communities of practice (CoP) [29] and to make their transition from college to the industry as effective as possible. One way that students access these CoPs is through internships. Internships allow students an opportunity to undergo experiential learning thereby enhancing an undergraduate's intellectual, personal, and ethical growth [9].

In this paper, we focus on understanding the impact that internships have on: CS students' career goals, students' perceptions of the gaps between academia and industry, and students' strategies for professional success. This research is a part of a larger study aimed at understanding students' computing professional identity through the development of their technical competency in CS degree programs, professional experiences, and independent skill development [13].

2 BACKGROUND

2.1 Role of Internships in Future Employment

Internships have become an integral part of employers' recruitment process as they provide them the ability to evaluate potential candidates over an extended period of time in a working environment [19, 27]. Studies have shown that pursuing an internship is positively correlated with an improved chance of getting a full-time job offer and a higher starting salary [19, 27]. A 2017 National Association of Colleges and Employers (NACE) survey reported a staggering 91% of employers considered candidate experience when making hiring decisions and half of the employers sought new graduates to be hired from an internship or

a co-op program [4, 7]. In addition, NACE also surveyed 44,000 students in 2014 and found that 52.1% of students with an internship or co-op who applied for jobs received at least one offer of a full-time position compared with 38.6% of applicants without the internship or co-op—a difference of 13.5% [19]. Thus, it is evident that internships are playing a key role in preparing students for their professional careers and in obtaining full-time positions. However, little is empirically known about the impact these internships have on CS students' career goals and the students' perceptions of the effectiveness of CS degree programs in preparing them for these opportunities.

2.2 Situated Learning, Communities of Practice

In the context of undergraduate degree programs, internships are one avenue for students to initially participate in computing communities of practice (CoP). Lave and Wenger's Situated Learning theory describes how individuals acquire professional skills through co-construction of knowledge when interacting in a social context, apprenticeship, or CoP [16]. Further, Wenger states that "Communities of practice are groups of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly" [29]. Wenger's CoP research extends research on apprenticeship, Situated Learning theory, and legitimate peripheral participation (LPP).

The theory of legitimate peripheral participation describes how members of CoP start off on the periphery of the community as a newcomer. As newcomers gradually gain understanding and mastery of key skills and practices valued by the community, they become more central to the functioning of the community and are eventually recognized as old timers within the community [16]. Throughout this process of participation in the community, members' identities are reconstructed and transformed as they seek to become full practitioners within the community. While there are official pathways to earning credentials to become part of professional CoPs, participation in the community is essential for recognition, acceptance, and membership within the community [29].

In the context of computing CoP, internships offer students, who are newcomers to the computing industry, a way to become members of a community by allowing them to participate in simple tasks that further the goals of the community/ organization. Through these peripheral activities, CS students become acquainted with the tasks, vocabulary, and organizing principles of the computing community and its practitioners.

2.3 Existing Research in CS Undergraduate Professional Development

Research in professional development described the lack of technical abilities, personal skills, and professional qualities in recent CS graduates [2, 22, 23], and the strategies for CS departments to prepare their students for their future careers using experiential learning [17]. Other research in professional development for CS undergraduate students has focused on the professional development of students through participation in capstone courses [21], project-based courses [6] or experience in internship programs developed through industry-academia partnerships [8]. This research includes Parker's study that found that software engineering capstone courses influenced CS students' professional identity formation, and aided them in exploring CS career options [21]. In another study, Fryling et al. found that a department-scaffolded internship program at Siena College had a positive impact on CS students' retention [8]. Research on CS industry internships is limited. However, Tomer and Mishra found CS students at an Indian university identified a gap between their academic training and their internship experience which led them to have mixed satisfaction with their CS degree program [28]. Further, Kapoor found that CS students at a US university who had industry internship experiences were more likely to have definitive career goals and were involved in student clubs and research experiences when compared with students who had not interned [14].

Overall several gaps exist in CS professional development literature (1) lack of extensive literature or qualitative studies that empirically gauge the impact of internships on CS students' professional goals; (2) studies on real-world internships as most prior studies focused on students' professional development through programs crafted by the university, or students' supervision in industry-academia collaboration by an academic supervisor [6, 8, 21]; and (3) studies gauging CS students' perceptions of gaps between industry and CS degree programs in the US as most prior studies focused on the gaps in industry-academia through the viewpoint of employers [2, 22, 23]. Therefore, in this study, we focus on understanding the role of internships on CS students' career goals and their perceptions on the effectiveness of CS degree programs in preparing them for their professional careers.

3 METHODS

3.1 Study Design

We designed a cross-sectional survey-based study focused on understanding the impact that professional internships have on CS students' career goals, students' perceptions of the gaps between academia and industry, and students' strategies for professional success. 97 students enrolled at the University of Florida in the United States participated and completed the survey in Spring 2016. The university had a population of 1519 undergraduate CS majors in 2016. The CS undergraduate degree program offered at our university allows students to major in CS, or Computer Engineering (CE). The students can choose a major when they start college but can change it at any time. For this paper, we report on the data of 40 CS undergraduate students who had an internship experience. In this study, we focused on exploring the following research questions:

RQ1. How do professional internships impact CS undergraduate students?

RQ2. What lessons can we learn from CS undergraduate students' professional experiences that can strengthen our academic curriculum?

RQ3. What lessons can students learn from CS undergraduate students' professional experiences that can aid to their professional success?

3.2 Participants Recruitment

Students were recruited from our university's CS1, data structures, software engineering, senior design courses, and several CS technical electives. The survey participants were given no more than 1% extra credit towards their final grade for participating based on pre-approval by the course instructors.

3.3 Participants

The age range of the participants was 18 to 23 based on the enrolled CS undergraduate population at our university. The details of the survey respondents are as follows: 148 students responded to our survey, 102 students completed more than 94% of the survey (Completion Rate: 68.9%). Out of the 102 students, 5 students did not major or minor in CS or CE. Thus, we were left with 97 CS/CE undergraduate students (see Table 1). Out of these 97 CS/CE students,

(a) 41.2% of 97 students interned (n=40);

(b) 48.2% of 81 students interned (n=39), excluding freshmen;

(c) equal proportion of males and females interned (Table 1).

For this paper, we exclude the data for students who did not have a prior internship experience. Thus, we report data on 40 CS undergraduates (41.24% of 97) who completed more than 94% of the survey and had an internship experience.

Table 1: Demographics of Study Participants (N=97)

Intern Experience	Academic Standing (By Year)					Gender*	
	1	2	3	4	5-6	M	F
Yes	6.7% n=1	57.1% n=8	44.8% n=13	42.4% n=14	80.0% n=4	40.5% n=30	40.9% n=9
No	93.3% n=14	42.9% n=6	55.2% n=16	57.6% n=19	20.0% n=1	59.5% n=44	59.1% n=13
*Note: One student did not specify gender and interned.							

3.4 Data Collection

We gained consent from the Institutional Review Board at our university and used Qualtrics to administer the survey. The participants were asked to complete a consent form prior to the survey. The survey consisted of 3 demographic, 36 multiple choice, and 16 open-ended questions and was completed on average within 32 minutes. For this paper, we focus on 6 open-ended questions that are relevant to answer our research questions (see Table 2). We also use three demographic questions on gender, major and academic standing; and one multiple choice question on whether they participated in an internship.

3.5 Data Analysis

We analyzed student responses to six open-ended questions using inductive content analysis and thematic analysis in Microsoft Excel. We were following a grounded theory process of inductive coding [25]. We started with the raw data and created codes inductively using words from participants responses. The first author created primary codes which were then clustered to form categories, and these categories formed the basis of our codebook. We coded 129 student responses into 150 unique primary codes, which were clustered to form 78 categories. We then combined these categories into themes. 11 themes emerged to answer our three research questions: 4 for RQ1, 4 for RQ2, and 3 for RQ3.

To verify the reliability of the first author's coding scheme, the second author performed the inter-rater reliability at theme level on 36% of the dataset chosen at random. The Cohen's Kappa was an average of 0.72 for the coding scheme which qualifies as a substantial agreement [15]. 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 was recoded. Table 3 highlights an example of our inductive content and thematic analysis. 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%.

Table 2: Survey Questions to Answer Our Research Questions

Research Question	Survey Questions
RQ1. How do professional internships impact CS undergraduate students?	Describe the impact of internship experiences on your career goals and interests.
RQ2. What lessons can we learn from CS undergraduate students' professional experiences that can strengthen our academic curriculum?	* How well has the CS curriculum here at the university prepared you for industry and/or research professional experiences? * Can you think of a course whose use/ application was way different in the industry than as taught here at the university? * Describe your experience in the CS/CE degree program? Reflect on the quality of your academic experience. * Please provide additional comments or suggestions for improving the degree program and experience at the university.
RQ3. What lessons can students learn from CS undergraduate students' professional experiences that can aid to their professional success?	Reflecting on your degree experience, what advice would give to students enrolled in this program to improve their experience in the program and their professional success?

Table 3: Example of Inductive Content and Thematic Analysis

Survey Question: Have you participated in any internships? If yes, how did it affect your career goals and interests?			
Raw Data	It made me *like my career* even more	It made me *not want to change my CS major* anymore	Helped me to *decide on CEN* [Computer Engineering]
Primary Code	Like a CS career	Not change a CS major	Choosing Computer Engineering
Category	Strengthened to pursue a CS career	Strengthened to pursue a CS major	
Theme	Strengthened students' commitment to CS		

4 FINDINGS

4.1 Impact of professional internships

We analyzed student responses to an open-ended survey question: *Have you participated in any internships? If yes, how did it affect your career goals and interests?* 34 students who interned responded to this question. Four themes emerged from our data on the impact of professional internships on CS undergraduate

students' career goals (RQ1). These themes and their respective frequencies are shown in Table 4.

Table 4: Themes for Impact of Internships on Career Goals

Themes for Impact on Career Goals	n (N=34)	%
strengthened students' commitment to CS	14	41.1%
encouraged exploration of CS careers and industries	12	35.3%
promoted personal/professional growth	6	17.6%
developed awareness of professional expectations	5	14.7%

4.1.1 Strengthened students' commitment to CS

We found that internships played a crucial role in strengthening CS students' commitment to pursue a CS major or CS careers. 41.1% of 34 students (n=14) mentioned that the internship had a positive impact on their career goals: strengthened their career goals, increased their interest in CS, or increased their determination to pursue a CS major. The two most prominent categories in this theme included: strengthened their commitment to pursue a CS career and strengthened their commitment to pursue a computing major. The three students who belonged to "strengthened to pursue a CS major" category were either sophomores or juniors. Representative quotes from students belonging to this theme include:

It has given me experience as well as encourage me to stay with computer science - Male, Senior

It made me not want to change my CS major anymore - Female, Sophomore

It made me more determined to get my degree in CSE - Male, Junior

4.1.2 Encouraged exploration of CS careers and industries

Within this theme, we found that internships were allowing CS undergraduates to explore areas within CS as well as industries or work cultures of different types of companies. This exploration led 35.3% of 34 students (n=12) to determine their interests and dislikes. 58% of 12 students (n=7) whose responses were coded in this theme had a negative experience and wanted to avoid a CS area such as Information Technology or Web Development or a certain type of company or industry like military or an established corporation after their internship. On the other hand, 33% of 12 students (n=4) had a positive impact and wanted to work for the same company or a CS area. One student had both a positive impact to work in an area as well as a negative impact to avoid a different area. Those who had a negative experience were willing to explore a different area in the future. Some representative quotes from this theme include:

It significantly affected my career goals. It made me more interested in simulation and in working for government contracted companies - Male, Senior

I know more about what interests me and which fields of study to avoid - Female, Sophomore

I have interned as an IT tech for a construction company. It made me not want to work in IT ever again - Male, Junior

4.1.3 Promoted personal/professional growth

In this theme, students explained that internships helped them to grow personally as well as professionally. The personal growth was not only limited to an increase in their knowledge and skills, but the student's responses also pointed out evidence of growth in dispositional temperament including confidence and responsibility. This growth had an agentic influence on students' behavior helping them to pick future courses or decide CS specialization areas. The internship also provided them with an opportunity to get subsequent job offers.

Taught me to teach myself things - Male, Junior

I loved my internship. It finally made me confident about my abilities in computer science - Female, Senior

Lead to the acquisition of a post graduate job - Female, Senior

4.1.4 Developed awareness of professional expectations

CS students who participated in internships indicated that internships shaped their outlook on the tech industry, and they gained awareness about professional expectations in industry. Students explained that internships provides them with a new perspective on working in the industry and their CS degree.

It allowed me to see what it was like working in a professional environment and how working in a company would be – No gender specified, Sophomore

It helped me understand how the industry works actually. I did realize that I might not want to do the work I was doing in my internship but look at something else - Female, Senior

4.2 Students' perceptions of the effectiveness of their CS degree program

To gauge students' perception of their curriculum's strength in preparing them for the professional experiences, we asked them: *How well has the CS curriculum at the university prepared you for industry and/or research professional experiences?* We found two primary themes: Effective and Needs improvement. In addition, 8.6% of 38 students (n=3) who responded to this question were not sure about the program's effectiveness.

47.4% of 38 students (n=18), considered the curriculum to be "Effective". These students felt that the curriculum prepared them exceptionally or adequately for their professional development including for getting jobs or for interviews. Students also pointed out that the curriculum has prepared them to learn new topics, as well as advanced classes were effective in preparing them for the industry.

Pretty well I'd say. It has taught me to teach myself how to code in new languages at least - Male, Senior

It has prepared me enough to land me a job [internship] at Lockheed - Female, Freshman

Decently well, judging from interviews - Male, Junior

44.74% of 38 students' responses (n=17) were categorized into "Needs improvement" theme. In this theme, students reported that the curriculum fairly or poorly prepared them for their professional careers. In addition, students found the curriculum to be more geared towards preparing them for graduate school or research, and several other students perceived their prior knowledge or self-initiatives to learn new languages and tools were necessary for preparing them for their future careers.

The curriculum is more geared towards students pursuing graduate school or research - Male, Junior

Only somewhat. It's been mostly personal investment in different technologies. [University] only provides the "paper" that allows you to get in the door. The rest is on you - Male, Sophomore

For my internship, I taught myself two languages and used little of what I learned in school - Female, Senior

It gave me some good base knowledge of things, which is helpful. But all of the tangible skills that I have that actually earned me a job, were self-taught or taught to me by another entity - Male, Junior

To better understand the CS students who reported that the curriculum needs improvement, we used their comments from several questions in the survey where they explained how academia was different from the industry (see Table 1). 13 students provided feedback on the distinction. We found two themes which answered RQ2. These themes included the need for a broader curriculum; and better alignment between languages, tools, and frameworks used in industry and academia.

4.2.1. Need for a broader curriculum

Six CS students mentioned that the CS academic degree programs need more industry or job-related courses, and holistic improvement of pedagogical practices. The key issues students emphasized in this theme included offering more tech electives, fewer general education credits, optional hardware courses, and including practical applications in theory heavy courses.

Better balance of theoretical and skill driven CS skill and more app development classes - Male, Junior

For my internship, I taught myself two languages and used little of what I learned in school. I wish the CS department would teach more real-world applications of code and teach both coding and concepts in lecture rather than deeply relying on concepts and letting you figure out the rest on your own - Female, Senior

4.2.2. Better alignment between languages, tools, and frameworks used in industry and academia

Seven CS students stated that a programming language, framework, tool, or methodology used in academia was not used in the industry. They commented on the ubiquity of the agile software development model in the industry, and less usage of languages like C++ and Java in the industry.

Another thing I think should be changed is the focus on C++. In my first couple years here, I thought C++ was this great language and it would come in handy to know it well since I was using it in multiple classes. Then, when I went to interview with companies, not a single one even touches the language. I think it's important to teach a C-based language to have that experience, but it should be limited to one class. There are so many other languages in which knowledge of them will actually benefit us, that we should be using - Male, Junior

4.3 Student Strategies for Professional Success

Our third research question focused on the lesson's students can learn from professional and academic experiences that can help other students for their professional success. 37 students responded to a question: *Reflecting on your degree experience, what advice would give to students enrolled in this program to improve their experience in the program and their professional success?* We found 28 unique categories from 37 student responses. Three themes emerged from these categories: Work outside curriculum, Be strategic in coursework, and Have social supports and network.

4.3.1 Work outside curriculum

In this theme, 54.1% of 37 students (n=20) recommended that their peers do work/learn outside the CS curriculum. Prominent strategies in this category included: Learning outside school (8), Getting involved with student organizations (7), Doing side projects (6), Learning to program for interviews and industry (5) and Doing internships (4).

Do a lot of practice in your free time by visiting programming contest websites (SPOJ *and the likes), watch YouTube videos, but most importantly GET INVOLVED* - Male, Junior

Sign up for the right professors, get an internship early, get really good at learning outside the classroom - Male, Senior

I would encourage other students to get internships to experience what the computing field is actually like. The classes at university don't give a good indication of what it's like to work in the professional field at all - Female, Sophomore

School is not enough to be successful in this field, you must learn a lot on your own and topics that are being discussed/introduced in the industry - Male, Junior

4.3.2 Be strategic in coursework

In this theme, 54.1 % of 37 CS students (n=20) suggested strategies to follow during the CS degree program. Prominent strategies in this category included: Taking courses offered by specific professors (6), Working hard and not procrastinating (6), Taking courses with projects and working hard in them (3), Teaching yourself before classes (2), Taking courses to determine interests (2) and Taking electives in areas of interest (2).

Take a wide variety of courses early to find out what does and does not interest you. Don't seek electives that are easy, but rather interesting - Male, Senior

Work hard on your projects and make sure to do a good job, as opposed to just doing what you need to do to get by. If you slack off you will have a lot of catching up to do before attending and interview or actually going to a job - Male, Junior

4.3.3 Have social supports and network

In this theme, 24.3% of 37 students (n=9) advised other students to make friends in CS/classes, talk to TA's and Professors, attend office hours, do networking, and take advice from seniors for professional success or a better CS degree program experience.

Make lots of connections. Make friends with your TAs, professors, and classmates. It makes the course so much more enjoyable and easier - Female, Freshman

I would suggest them to talk to professors and their seniors and try various things in their initial years to figure out what they like and then focus on that field in the later years - Female, Senior

5 DISCUSSION AND CONCLUSION

Our paper contributes to the CS professional development literature in the following ways:

Explaining the impact of internships on students' career goals. Our findings suggest that industry-based internships are

playing a crucial role in retaining CS students in computing programs, promoting exploration of different areas of computing and computing careers, and developing awareness of professional expectations. Thus, these industry internship avenues serve as pathways for CS students to become members of professional CS communities of practice (CoP). Further, these internship experiences are influencing CS students' to either continue pursuing a specific CS area or to explore another CS area in the future based on their experiences as they explore different professional CS CoPs. These findings are crucial as prior research has shown that that CS students have misconceptions about computing or its specializations [1, 10, 11, 18]. Our findings also suggest that CS students may like or dislike a certain CS area after their internship and this experience may lead them to avoid or lean towards a specialized CS area after their internship. This finding extends prior research on CS students' selection of CS specialization which states that CS students' pick specializations based on their enjoyment in individual classes [10]. In addition, our findings on students' retention/commitment to a CS major after industry-based internships extend prior results from Siena College [8] who found that a department-based CS internship program had a positive impact on student retention for upperclassmen.

Despite the benefits students found from participating in internships, finding from our study give cause for alarm as only 48% of CS students in our sample had at least one internship experience during their 2nd-5th year. We have found that these numbers are similar across junior (44%) and senior years (42%). Results from a Gallup-Purdue Index revealed that 61% undergraduate students use career centers for internship search assistance [19, 20]. Thus, further research is needed to better understand (1) the characteristics that differentiate successful internship applicants from unsuccessful applicants and (2) why students especially juniors and seniors have not had at least one internship experience, given that companies give preference to students who have had internship experiences [7, 19, 27].

Analyzing students' perception of the effectiveness of CS degree programs in preparing them for their careers. Overall, we found mixed responses from students completing at least one industry experience: 48% of the students felt that the curriculum is effective, and 47% CS students felt that the curriculum needs improvement in preparing them for the internships. Nationally, one-third recent U.S. college graduates strongly agreed that their internship allowed them to apply what they were learning in the classroom [24]. Internationally, Tomar and Mishra found CS students' reporting similar patterns of mixed satisfaction and dissatisfaction with CS degree program's preparation for industry experiences [28].

Students in our study recommended that the CS curriculum needs to be broadened to include more courses in web or app development, more practicality and project-based learning coursework, and inclusion of relevant programming languages that are used in the industry. These findings support prior work on the perceptions of employers reporting recent graduates to be struggling with software tools, and lacking project experiences [3, 22]. These issues prevent students from gaining employment.

Thus, degree programs need to ensure that these gaps are minimized by updating their curriculum frequently including programming languages, tools, frameworks, and new CS courses to better align the coursework with demands in the industry, ensuring there is a balance of practice and computing theory. These practices will better prepare our students for jobs in the industry and thereby satisfy the demand for CS graduates.

Identifying CS students' strategies for professional success. Overall, we found that students were working outside academia to gain additional skills needed to secure an internship or a full-time job. Moreover, they were recommending this strategy to other students. Thus, there is a need to understand what skills students are gaining outside of our curriculum that are helpful for their participation in industry internships. Further, we need to evaluate which skills we can integrate into our coursework so that all students can benefit from it and are provided with access to such resources in every university.

6 RECOMMENDATIONS

We highly recommend that students pursue at least one CS internship prior to completing their CS degree program. We also suggest that departments make internships mandatory for CS students given the role they play in students' professional development as well as the industry's predilection towards applicant's prior experience in the new graduates' recruitment process. Further, we recommend that departments ensure that their CS curriculum is effective in balancing theoretical and practical applications in computing, thereby preparing students for industry jobs, and reducing demand for lack of CS graduates.

7 OUR DEPARTMENTAL RESPONSE

In light of the findings from this study and engagement with the undergraduate student body and industrial advisory board, our department has reviewed its curriculum over the last two years. We have begun making significant changes in course structure and quality control to ensure our CS degree program and support programs are effectively preparing our students for jobs in the industry as well as providing the fundamental CS knowledge needed by computing professionals. We have also begun offering internship workshops and seminars for freshmen and sophomores in collaboration with student organizations.

8 LIMITATIONS

The findings presented in this paper represent a snapshot of the internship experiences taken from a small sample of CS students at a large US-based university. Hence, the findings may not generalize to large populations of students at similar or different institutions or experiences of CS students in other countries. Further, in the future, additional data on the type of internship, area and type of company might help to better characterize the population. Lastly, given that this study gave students extra credit at the end of semester, the study population could be skewed towards high performing students that wanted to take every opportunity to secure a good grade in their course or low performing students that wanted an extra grade boost.

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