Barriers to Securing Industry Internships in Computing

Amanpreet Kapoor & Christina Gardner-McCune, Ph.D.
Engaging Learning Lab
Computer and Information Science and Engineering
University of Florida, Gainesville, FL, USA 32611 • kapooramanpreet@ufl.edu
Motivation

Ubiquity of Computing Jobs in the Coming Decade

Source: https://code.org/images/cs-stats/more-jobs-than-students.png
Motivation

Underprepared Computing Graduates

Underemployed CS Recent Graduates

Employers report CS graduates lack

- Technical abilities
- Personal skills
- Professional skills

Source: The Labor Market for Recent College Graduates

Sources: Brechner. Things they would not teach me of in college (OOPSLA 2003);
Radermacher & Walia. Gaps between industry expectations and the abilities of graduates (SIGCSE 2013, ICSE 2014);
Create pathways for smooth transition of students from college to industry ensuring that the CS graduates are technically and professionally competent.

Source
Joint Task Force on Computing Curricula, Association for Computing Machinery (ACM) and IEEE Computer Society. 2013. Computer Science Curricula 2013: Curriculum Guidelines for Undergraduate Degree Programs in Computer Science. Association for Computing Machinery, New York, NY, USA.
Role of Academic Institutions

Create pathways for smooth transition of students from college to industry ensuring technically and professionally competent CS graduates.

PROFESSIONAL DEVELOPMENT
Existing Research in CS Undergraduate Professional Development

Source:
- Alvarado and Spring (2018). Successfully Engaging Early Undergraduates in CS Research. SIGCSE '18
- Kapoor and Gardner-McCune (2019). Understanding CS Undergraduate Students’ Professional Development through the Lens of Internship Experiences. SIGCSE '19
- Dean, Lynch, and Ramnath (2011). Student perspectives on learning through developing software for the real world. FIE '11
- Parker (2018). Developing Software Engineers: A study of professionalization in a CS Senior Capstone. SIGCSE ’18
Motivation

Professional Development through Internships

Internships

- Gain authentic experiences\textsuperscript{1,2}
- Build technical skills\textsuperscript{1,2}
- Develop professional skills\textsuperscript{1,2}
- Secure future employment\textsuperscript{3}

Source

1. Amanpreet Kapoor, Christina Gardner-McCune. 2019. Understanding CS Undergraduate Students’ Professional Development through the Lens of Internship Experiences. SIGCSE ’19
Motivation

Professional Development through Internships

Internships

- Gain authentic experiences\(^1,2\)
- Build technical skills\(^1,2\)
- Develop professional skills\(^1,2\)
- Secure future employment\(^3\)

Participation in Internships before Graduation across all majors in the US\(^3\)

Source

1. Amanpreet Kapoor, Christina Gardner-McCune. 2019. Understanding CS Undergraduate Students’ Professional Development through the Lens of Internship Experiences. SIGCSE ’19
What **barriers** do CS undergraduate students, who do not intern, encounter in securing an industry internship?
Bandura’s Social Cognitive Theory elaborates on

1. **Human agency**: actual ability to deal with a complex task

2. **Self-efficacy**: the belief that one has about their capacity for specific achievements, given domain-specific obstacles

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.

*Source*
Albert Bandura (1989). Human agency in social cognitive theory

Lent, Brown, and Hackett’s Social Cognitive Career Theory (SCCT) elaborates on

(1) formation of career-relevant interests;
(2) selection of career choices;
(3) performance and persistence in educational and occupational pursuits

People are likely to develop interest and pursue a career if they have strong self-efficacy beliefs, outcome expectations, and environmental support for gaining professional competence.

Source
Typical Hiring Process for Internships in USA

Applying at Career Fairs or Online for Paid/Unpaid/Coop Internships in Computing Disciplines

Screening of Resume by Application Tracking System, Referrals, or Recruiters or a Technical/Aptitude Test

0-4 remote or in-person Technical (Coding + Data Structures + System Design), and/or Behavioral interviews.

Expectations: Technical Skills + Professional Skills + Working outside the curriculum
Study Design & Institutions

- **Cross-sectional** mixed-methods (survey and interview) study at two large public R1 universities in South East USA in Spring 2019
  - University of Florida
  - Georgia Institute of Technology

- At both universities
  - Students can choose a major when they start college but can change at anytime
  - Internship is not required for graduation
Participants included in Data Analysis

Participation in Internship before Graduation (N=529)

Dataset:
302 students who never interned or were not interning the summer following the study
Participants included in Data Analysis

- **N = 302**
  - University of Florida (n=285, Response Rate: 44.0%)
  - Georgia Institute of Technology (n=17, Response Rate: 18.4%)

- **Average Age: 21.1 years (SD: 4.1)**

- **Average GPA: 3.44 (SD: 0.47)**

- **Recruitment through**
  - Extra credit in Computing Courses (n=299)
  - Random Gift Card (n=3)
Participant Demographics

Gender Identity, N=302

- M, 73.8%
- F, 25.5%
- Others, 0.7%
Participant Demographics

Gender Identity, N=302
- M, 73.8%
- F, 25.5%
- Others, 0.7%

Racial/Ethnic Identity, N=302
- White, 43%
- Asian, 29%
- Hispanic or Latinx, 20%
- African American, 6%
- Others, 2%
Participant Demographics

Gender Identity, N=302
- M, 73.8%
- F, 25.5%
- Others, 0.7%

Racial/Ethnic Identity, N=302
- White, 43%
- Asian, 29%
- Hispanic or Latinx, 20%
- African American, 6%
- Others, 2%

Major, N=302
- CS, 69%
- Computer Engineering, 22%
- Digital Arts and Sciences, 3%
- CS minor, 3%
- CS double major, 3%
- Unspecified, 0%
Participant Demographics

Gender Identity, N=302
- M, 73.8%
- F, 25.5%
- Others, 0.7%

Racial/Ethnic Identity, N=302
- White, 43%
- Asian, 29%
- African American, 6%
- Hispanic or Latinx, 20%
- Others, 2%
- Others, 6%

Major, N=302
- CS, 69%
- Computer Engineering, 22%
- Digital Arts and Sciences, 3%
- CS minor, 3%
- CS double major, 3%
- Unspecified, 0%

Academic Year, N=302
- Year 1, 43.1%
- Year 2, 17.2%
- Year 3, 23.2%
- Year 4, 11.3%
- Year 5-6, 2.6%
- Other Standing, 2.6%
## Data Collection and Analysis

### Why haven't you interned so far?

<table>
<thead>
<tr>
<th>Raw Data</th>
<th>Primary Code</th>
<th>Categories</th>
<th>Themes</th>
</tr>
</thead>
<tbody>
<tr>
<td>I'm not sure how to begin finding an internship and I have a lot of anxiety and feel incompetent. -P327, Year 3 Female</td>
<td>Intimidation to apply</td>
<td>Lack of Confidence and Fear</td>
<td>Low self-efficacy</td>
</tr>
<tr>
<td>I think because I lack the skills and personal projects to compete with much more experienced students. -P382, Year 5-6 Female</td>
<td>Self-evaluation: lack of skills</td>
<td>Self-evaluation: lack of skills and experience</td>
<td></td>
</tr>
<tr>
<td>Lack of adequate experience as a freshman, course load and study abroad as a sophomore. -P722, Year 2, Female</td>
<td>Self-evaluation: lack of experience</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

[Barriers to Securing Industry Internships in Computing | ACE 2020 | Amanpreet Kapoor & Christina Gardner-McCune, University of Florida]
RQ. What **barriers** do CS undergraduate students, who do not intern, encounter in securing an industry internship?

Themes (N=302)

- Low self-efficacy: 49.30%
- Actions: 37.40%
- Alternate priority: 33.80%
- Application process challenges: 5.30%
Findings : Barriers to Securing Internships

Low self-efficacy (n=149)

- **Self evaluating** as technically incompetent (n=85) through lack of experience in appropriate coursework, or little/no involvement in activities outside of coursework such as personal projects and technical interview preparation.

- Expressed lower self-efficacy by using “age”, “academic status”, or “year in degree program” as a proxy for knowledge (n=71).

- Reported lacking dispositional traits through feelings such as lack of “confidence” or felt “intimidated” to apply (n=19).
Findings: Barriers to Securing Internships

Low self-efficacy (n=149)

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

- P376, Senior Male
Findings: Barriers to Securing Internships

Low self-efficacy (n=149)

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

- P376, Senior Male

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

-P287, Sophomore Female
Findings: Barriers to Securing Internships

<table>
<thead>
<tr>
<th>Low self-efficacy (n=149)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Females (n=45, N=77)</td>
</tr>
<tr>
<td>58%</td>
</tr>
</tbody>
</table>

Gender

Females (n=45, N=77) 58%  Males (n=103, N=223) 46%

49.30% 37.40% 33.80% 5.30%
Findings: Barriers to Securing Internships

Low self-efficacy (n=149)

Gender

- Females (n=45, N=77): 58%
- Males (n=103, N=223): 46%

Academic Year

- Year 1 (n=88, N=130): 67.70%
- Year 2 (n=17, N=52): 32.70%
- Year 3 (n=26, N=70): 37.10%
- Year 4 (n=10, N=34): 29.40%
Findings: Barriers to Securing Internships

Actions (n=113)

- Applying but failing due to less involvement, technical interview challenges, etc. (n=47)
- Not applying due to low GPA, low confidence, socio-economic challenges, etc. (n=31)
- Will apply in future and working on building skillset (n=18)
- Ambiguity on intent to apply (n=13)
- Applied-secured-and-declined (n=5) due to low offered stipend, shifting priorities
- Not applying because of secured full-time employment (n=2)
Findings: Barriers to Securing Internships

| 49.30% | 37.40% | 33.80% | 5.30% |

Actions (n=113)

“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 parent's financials.”

-P183, Senior Male
Findings: Barriers to Securing Internships

Alternate priority (n=102)

- Coursework or GPA (n=67): managing time was difficult or believed coursework would prepare them
- Work/Financial or Family responsibilities (n=26)
- Involvement in activities outside of coursework in summer (n=14)
- Health conditions (n=2)
Findings: Barriers to Securing Internships

Alternate priority (n=102)

“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
## Findings: Barriers to Securing Internships

| Alternate priority (n=102) | 49.30% | 37.40% | 33.80% | 5.30% |

- **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

- “**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
Findings: Barriers to Securing Internships

Alternate priority (n=102)

Coursework/GPA

- Females (n=23, N=77): 29.9%
- Males (n=43, N=223): 19.3%

Family/Work Responsibilities

- Females (n=4, N=77): 5.2%
- Males (n=22, N=223): 9.9%
Findings: Barriers to Securing Internships

Application process challenges (n=16)

- Limited knowledge of how and where to apply for internship positions
- Lacked connections to apply for internships
- Visa restrictions
Findings: Barriers to Securing Internships

Application process challenges (n=16)

“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
## Findings: Barriers to Securing Internships

<table>
<thead>
<tr>
<th></th>
<th>49.30%</th>
<th>37.40%</th>
<th>33.80%</th>
<th>5.30%</th>
</tr>
</thead>
</table>

### Application process challenges (n=16)

- "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
- "I have not interned so far because my **status** with the United States does not allow me to obtain a job."
  - P129 Freshman Female
Findings

Barriers to secure industry internships in Computing

4 Themes

Low self-efficacy
- Self-evaluation: incompetence, lack of skills, lack of involvement outside the curriculum
- Using academic status as a proxy for knowledge
- Lack of confidence and fear

Actions
- Applying but failing due to less involvement, low GPA, technical interview challenges, etc.
- Not applying due to low GPA, low confidence, socio-economic challenges, etc.
- Will apply in the future
- Applied, secured, and rejected
- Ambiguity regarding applied or did not apply
- Not applying as secured a full-time job with existing employer

Alternate priority
- Coursework
- GPA
- Family responsibility
- Work/financial responsibility
- Involvement in activities outside of coursework in summer
- Health

Application process challenges
- Lack of knowledge on how and where to apply
- Administrative barriers
- Lack of connections

18 Categories

Barriers to Securing Industry Internships in Computing | ACE 2020 | Amanpreet Kapoor & Christina Gardner-McCune, University of Florida
Discussion

- Students’ **self-evaluation** of their skillset
- Students’ **misconceptions** regarding internship process
- SCCT suggests that during the career exploration process students face obstacles that hinder the formation of performance goals

Students lacked the necessary agency to form performance goals

**Source**
CS students fail to secure an internship not only due to less technical proficiency, but also due to:

- **Psychological constraints**
  - E.g. low self-efficacy and lack of agency

- **Financial constraints**
  - E.g. work responsibilities

- **Social constraints**
  - E.g. family responsibilities

- **Recruitment-process constraints**
  - E.g. involvement in projects & extra-curricular activities
Recommendations

- Departments should support specific professional development programs targeting students who have work/family responsibilities or for building students’ confidence.

- Departments must disseminate the importance of pursuing internships.

- Instructors must incorporate authentic skills required from the industry recruitment process within the curriculum so that all students can balance coursework with professional development.
Acknowledgements

Data Collection
Michael Hewner
Jennifer Whitlow
Joshua Gross
Victoria Hong
Jeremiah Blanchard
Joshua Fox
Philippa Brown
Peter Dobbins

Feedback on Draft
Kimberly Ying

Funding/Travel
SIGCSE Special Project
May 18 – Dec 19
UF Graduate Student Council

Questions?
✉️ kapooramanpreet@ufl.edu

Any opinions, findings, conclusions, or recommendations expressed in this presentation are those of the authors.