Board 393: Supporting Student Internships with the Nsf Hsi Program at a Medium-Sized Hispanic-Serving Institution

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I. Introduction

Our work describes the initial findings for a recent NSF IUSE HSI HRD grant. Its goal is to have the university facilitate students in finding major-related internships. The long-term plan is to sustain this model after the grant. By developing intervention strategies, we improve student success in the internships. The University does not have an existing internship pipeline of this nature. Students often have trouble finding internships relevant to their degree. Most university students in this program are non-traditional, community-college transfers, underrepresented minorities and/or low-income. They often work 20-40 hours a week in jobs unrelated to their course of study. The Program compensates interns through financial aid scholarships. It aims to replace their unrelated work experiences with relevant, real-world engineering internships.

Most NSF-sponsored projects like our work are awarded to two-year institutions and are research-related. This sponsoring University is a four-year institution. The Program focuses on non-academic, industry-connected internships. In the following, we describe our experiences implementing the internship pipeline. We share best practices for individuals who hope to follow our model. Conclusions from the evaluation team are highlighted. The challenges overcome by the team were rewarding to both students and the faculty team. Multiple program review interviews indicated that the internships provided to the students had a lasting impact on their career directions. Most participants indicated that University facilitation of the internship was the key factor in gaining an internship during the academic year. Local internship-providing companies (generally smaller employers) were found to be receptive in providing student internships. The active connection provided by the University department was a key factor in creating the internship opportunities.

II. Background and Related Programs

Many current students are non-traditional. The definition for non-traditional students can vary. A general definition might include students older than 25, a single parent, financially independent from their parents, and/or working full-time [1]. The Department's primary demographic is non-traditional and Underrepresented Minority (URM). These individuals suffer from reduced retention rates and longer timeline to graduation [2, 3, 4, 5]. Non-traditional students often use non-curricular work to finance their education. This employment is most often temporary non-STEM jobs [6]. Working less than 15 hours per week can be beneficial to an educational program [7]. Non-traditional students often work at least 20-40 hours per week. The same report identifies these longer work hours as a risk for academic success. Low-income students with substantial work hours that are not major related have an academic disadvantage compared with student who do not need to work. [8]. This is an equity problem.

Our goal is to preempt the need for non-curricular work by providing internships to students. Internships relevant to an individual's course of study improve job placement after graduation. By practicing concepts learned in the classroom, students find utility with their degree. Their confidence improves. The purpose of the grant is to jump-start an internship pipeline. The department plans to continue fostering corporate relationships so that the internship pipeline for students remains strong.

The Program is similar to the the Federal Work Study (FWS) program. FWS is financial aid in exchange for a light workload. A review of 30 other works finds no consensus about outcomes with FWS [9, 10]. FWS caps effort to 10-15 hrs./wk. during the academic year. This limitation exists so as not to interfere with class. Yet, non-traditional students work full-time and

year-round for financial reasons. Our scope of work differs from the well-known National Science Foundation (NSF) Research Experiences for Undergraduates (REU) because it is not research based or academic. There are a few other awards like our work. The Welty Environment Center (WEC) was recently awarded a grant from the NSF GEOPAths program (NSF 23-540). WEC's grant focuses on high-school outreach and environmental conservation, whereas we focus on improving undergraduate STEM education. There are many examples of two-year institutions obtaining funds for IT internships. Some examples are Northern Virginia Community College's SuperPL program funded by the NSF Advancing Innovation and Impact in Undergraduate STEM Education at Two-year Institutions of Higher Education; an award to the Wake Technical Community College focusing on cloud-based technologies; and Portland Community College's Enhancing Geographic Information Science Technology Education (eGIST) focusing on GIS internships, funded by the Education and Human Resources division of the NSF. To the best of the author's knowledge, our work is novel in that we focus on grant-supported industry-based, non-academic, non-research, and four-year-institution internships.

III. Methodology

The University possesses no STEM-related FWS or grant-supported internship programs. We chose not to sub-award industry partners—this would cause administrative and legal difficulties. Instead, corporations agree to host an internship that is technically unpaid. In parallel, students are awarded a financial aid scholarship in an amount commensurate to their effort. The proposal budgeted $5,000 per participant and planned for 12 participants. This amount is typical for scholarships at the University. For reference, the NSF recommends $600 per participant per week for the NSF REU program or $6,000 over a ten-week period (NSF 22-601). The grant team organized many meetings to pursue Memorandums of Understanding (MOU) with a few industry partners. The team frequently met with partners to agree on the internship parameters. After the execution of an MOU, the grant team advertised, solicited participation in the program and aggregated the applications to the corporations for review. Corporations retained the ability to conduct an independent hiring process. The academic team was not materially involved in the projects beyond administratively screening the applications before forwarding them to the corporations. The University administration was concerned about preventing corporations from firing interns without due process. Corporations agreed to provide monthly feedback about interns. The feedback enables the grant team to conduct an intervention and mentorship if necessary. Thankfully the team did not have to implement any interventions.

Three corporations (A, B and C) joined the grant proposal submission. Corporation A is a small software engineering corporation offering Computer Science internships. Corporation B is a small engineering corporation specializing in wireless technologies, offering Computer Engineering internships. Corporation C is a large petrochemical extraction corporation offering Computer Science and IT internships. Post award, the team pursued MOU to formalize an internship pipeline. Corporation B backed out of the partnership citing financial hardship due to the COVID-19 pandemic. Corporation C did not follow up on attempts to formalize a partnership.

The team spent considerable effort to find more internship hosts. One candidate was a small start-up, a government contractor. Talks were fruitful, but after a lengthy, almost year-long negotiation process a newly appointed CEO was not receptive to hosting internships from our university. The team found success with another corporation, Company D. They are a small corporation specializing in web development, and offered Computer Science internships. The team is presently seeking out more internships hosts.

The grant's internal and external evaluation team evaluated internship quality. An IRB exemption was obtained to collect human subject data (IRB number TBA). Data collection activities consisted of three items:

- At the start of the program, participants completed a survey. Major themes the importance of the Program in obtaining their internship, and self-identifying goals for the internship.
- Halfway through the internship, the evaluation team met with the students over Zoom to determine their satisfaction, general feedback, and to reflect if they were meeting their self-identified goals from the survey.
- After the internship concluded, the team met with the students a final time. Again, the themes of the conversation are satisfaction, feedback, and reflection on self-identified goals.

Students were informed that the surveys and interviews were anonymous. They were an important formative evaluation tool to determine if corporations should continue on with the program.

IV. Discussion

The grant team experienced many challenges but overall was an important experience for the participants. At first glance, not many applications were received, when compared to the number of expected participants (12). The compensation package was low. Finding corporations or agencies willing to host an internship was difficult, and the MOU formalization process was quite long. Formative evaluation of internship participants is critical to ensure students have successful internships.

Corporations A and D joined the Program for a first-round cohort. The program's goal was to hire six interns in year one, and six were hired. 17 applications were received for the first pool of applicants. The Department has approximately 600 majors, with 50 among them completing their capstone/senior project experience—who would be considered qualified to apply. Thus, while 17 seems a low number compared to the goal of six hires, it is overall a high response rate (34%). The Program experienced success in this area due to effort by the team. Instructors brought up the program with students in class. In one case, the PI sent personalized messages to every student in their classes, asking them to apply.

Table 1: Compensation for internships of students held at the University. 16 Week Stipend: Approximate participant cost assuming 0.5 FTE.

Position	**Wage**	**16 Wk. Stipend**
The Grant participants	$15.64	$5,000
Sales Management Intern, local retail*	$15-18	$4,800-5,760
Technology Professional Intern, local county government*	$18.99	$6,076
Manufacturing Integration Intern, large solar utility corp.*	$18-20	$5,760-6,400
Automation Specialist Intern, large fossil fuel extraction corp.	$20	$6,400
Engineering Technology Asst., large fossil fuel extraction corp.	$20	$6,400
Operation Engineering Internship, medium aerospace corp.*	$16-37	$5,120-11,840
Petrophysical Specialist, large fossil fuel extraction corp.	$44.27	$14,166
Production Engineer Intern, large Silicon Valley tech. corp.	$50**	$16,000
Software Engineering Intern, large Silicon Valley tech. corp.	$54.81	$17,539

*Self-reported by employer on Glassdoor, rather than confidentially volunteered information.
**In addition to a $6,000 mo. housing allowance.

For a ten-week internship, $5,000 is approximately $20/hr. at 0.5FTE. However, all corporations believed 10 weeks to be too short of an internship and preferred a full-term involvement (16 weeks). For a sixteen-week internship, $5,000 is approximately $15.63/hr. at 0.5FTE. This amount approaches the minimum wage in some states. Consider that the Grants goal is to supplant non-curricular work such as service jobs. Yet, at this compensation level was no

financial incentive. To supplement the low compensation amount student were allowed to claim 4 units of credit toward their degree as an elective course, in addition to financial compensation. A comparison of internship wages is given Table 1. *Anecdotal* refers to students at the University who confidentially volunteered wage information. Other sources are publicly available data from internships in the Region. Considering the minimum values, the average wage is \$27.17±15.86/hr. ($\pm 1\sigma$). The Program's wage below this distribution. In the first cohort, two interns threatened to resign their positions for other, higher paying internships. In the second cohort, one finalist rejected their internship offer for another. Other programs should consider prevailing wages. We believe salaries above \$27.17/hr. to be a good starting point. This corresponds to \$8,694 per participant for 16 weeks at 0.5FTE. The University does not approve of unpaid internships, which are legal only under certain conditions in the State. Thus, unpaid internships were not explored by this program.

Executing the MOU between the University and industry partners took considerable effort and is a major barrier to providing internships. The last contact with Corporation C was a claim that the MOU was still pending. Speculating, representatives from Corporation C remarked that \$5,000 was not enough compensation in the pre-proposal stage and may have soft-terminated their participation. It took as long as six months to a year to formalize MOUs, which is a considerable amount of time for pilot projects that are only a few years long. Others attempting to replicate this model should initiate MOU procedures before receiving award notification.

The evaluations conducted by the evaluation team were critical in determining if interventions and changes needed to be made to the internships or set of internship hosts. In the following, we compare Corporation A—a satisfactory internship host—to Corporation D—an unsatisfactory internship host whose participation had to be terminated based on student feedback. Three interns worked for Corporation A. Two did not apply to internships outside of the Program, and did not have any prior experience. Corporation A, despite being a small corporation with no prior internship pipeline provided mentorship to students:

- Interns were placed on real projects. Software development was the primary task.
- Interns were recommended to complete online training modules to address gaps in knowledge,
- Interns shadowed engineers as they developed their software application (using Pair Programming), Student feedback most often indicated that the industry mentors utilizing pair programming were very helpful and eager to help the interns learn the software tools. At first the students were mostly watching mentors create their project while narrating what they were doing. Later in the project mentors offered short segments were students led the programming while mentors helped them become successful. The dialog between the mentor and mentee during pair programming was helpful to both parties.
- There was regular communication between the corporation liaison and the grant team. Student interview sessions with the grant team in the middle of the internship were utilized to gauge progress from the students perspective. General feedback to the company not directly tied to the student interview contents was provided back to the corporate liaison.
- The interns met regularly with their engineer and the liaison.

There was an intake process where interns rotated from engineer to engineer until they developed a strong connection with someone and their specific task. One exceptional intern was allowed to code, rather than shadow their engineer. We are unable to explain the nature of the project due to MDNA agreements. However, they were generally pertaining to SCADA, automation, data collection workflows, and web interfaces. This contrasts with Corporation D, which provided little to no feedback to the participants or the Program:

- Interns were placed on a non-critical-path project that did not interfere with customer delivery schedules.

- The internship team was given a currently used software application to review its functionality. They were then tasked with updating the application but with a non-specific task list. There was little guidance or feedback given during the internship period.
- Interns needed to self-organize and did have a clear mentor relationship with Corporation D sponsors. The students formed an effective internal team management structure on their own initiative. They learned a new software set and diligently proceeded on their best estimate of where feature improvements were needed. They felt pride in the work that they had put together as a quasi-independent development team.
- Communication with Corporation D was challenging and communication delays to email inquires were slow.
- The interns met with their liaison only a handful of times. The corporation did not provide a final review or feedback on the students work that was delivered.

Corporation D asked the intern team to develop a copy of Jira, a professional project management software by Atlassian, which is a challenging task for a team of fresh interns. The team self organized, appointed its team leader, and attempted to implement the project in NodeJS. The university team's mid-internship evaluation interview was critical in keeping the students motivated and to help understand how Corporation D was not providing adequate mentorship. The University team provided feedback to Corporation D during the internship period but did not receive sufficient responsiveness. Corporation D was not invited to a second round of interns.

Three interns worked for Corporation D. One had prior experience as a freelance web developer. The year they applied to the Program, they "[sent] out nearly [fifty] applications for Summer internships to many different companies across the United States" and did not get any callbacks. A second intern worked for Corporation C outside of this program as an analyst and wanted more relevant experience. They sent out approximately 20 applications and did not get any other callbacks. A third intern had some prior experience as an undergraduate research assistant but not as a software engineering intern. They, too, applied to many corporations, such as LinkedIn but did not get any callbacks. Despite the potentially negative experience at Corporation D, participants still felt it was a learning experience. The major theme is that they applied to many internships, and the Program was the only internship that offered a callback. Finally, they would otherwise have had no software engineering internship before graduation, if not for the Program.

IV.A. Student Voices on Diversity and Inclusion

During the interviews (final and halfway through their internship), the team asked the students to express their perspectives/thoughts on diversity-related issues. Students reported that they have mostly benefited from the diversity during their internships. They acknowledge that diversity is complex and beyond the concepts of race and ethnicity, and they can learn better when they feel comfortable and welcomed in their job environments. The project was not just about accessing their voices but promoting their role as a transformative force in their work environment.

V. Conclusion

We recommend that institutions pursuing grant-supported internships review and learn from our model. Future grants should consider rising inflation and competition with other tech internships when determining how much to compensate participants. The typical NSF REU support package, if used as a baseline, may not necessarily be more competitive than other forms of work available to the students. When evaluating the grant, there must be frequent formative evaluations to determine if the goals of the program are being met, and the participants are satisfied with the nature of their work. Successful internship programs have students placed on real projects, the appointment of both industry and faculty liaisons, and a strong commitment from the corporation to train the interns. According to the participants, internships are an opportunity to network and build lasting professional connections. While students may be unable to turn every

internship into a full-time position, each experience will give them something much more valuable and long-lasting: relationships with professionals and co-workers. The connections they make during their time at an organization can be stepping stones to their next opportunity.

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