The Industry Scholars Program: An Immersive Professional Experience for Undergraduates

Dr. Breanne Przestrzelski, University of San Diego

Bre Przestrzelski, PhD, is a post-doctoral research associate in the General Engineering department in the Shiley-Marcos School of Engineering, where she seeks to innovatively integrate social justice, humanitarian advancement, and peace into the traditional engineering canon.

Before joining USD in August 2017, Bre spent 9 years at Clemson University, where she was a three-time graduate of the bioengineering program (BS, MS, and PhD), founder of The Design & Entrepreneurship Network (DEN), and Division I rower. In her spare time, Bre teaches design thinking workshops for higher education faculty/administrators at the Stanford d.School as a University Innovation Fellow, coaches a global community of learners through IDEO U, and fails miserably at cooking.

Dr. Chell A. Roberts, University of San Diego

Chell A. Roberts is the founding dean of the Shiley-Marcos School of Engineering at the University of San Diego. Before joining USD, Roberts served as the Executive Dean of the College of Technology and Innovation at Arizona State University.

Dr. Leonard A. Perry, University of San Diego

Dr. Leonard Perry (ISE) has research interests in the area of system improvement via quality improvement methods especially in the area of applied statistics, statistical process control, and design of experiments. Dr. Perry consults, instructs, and collaborates on quality improvement projects with representatives from biotech, health care, defense, and traditional manufacturing institutions. He has been an instructor for the Six Sigma Black belt training at the Six Sigma Institute for three years. He is a UCSD Certified Six-Sigma Master Black-Belt and an ASQ Certified Quality Engineer.

The Industry Scholars Program: An Organic Program Grown by Industry Professionals for Undergraduates

Abstract

The Industry Scholars Program (ISP) is a year-long program designed by [[University]] industry partners and first launched in Spring 2017. In the first year of the ISP program, first and second year undergraduate students were introduced to professional skills through experiential workshops, industry site visits, and internships planned and coordinated by industry partners. The first cohort of 27 Industry Scholars were exposed to skills such as teamwork, emotional intelligence, and communication in a series of experiential learning workshops, which preceded a summer industry internship where those skills were built upon. Following these internships, students engaged in one final semester of professional skill development through additional workshops, industry site visits, and additional experiential learning, after which student feedback was captured. The proposed program outcomes as identified by the ISP planning committee were all achieved, with significant growth in areas such as abilities to describe and discuss expected engineering and leadership skills, ability to interview, self-awareness, and effectiveness at communication. This work introduces an industry-university collaborative program that can be a model for innovative universities and industries across the country seeking to prepare and secure students equipped with both professional and technical skillsets, both of which are required to flourish in their fields of engineering.

Introduction

Higher education has become a place where many students go to prepare for the workforce; unfortunately, students may not be leaving prepared. In a time when there are more American college graduates than ever before, the workforce preparedness of these graduates is staggeringly bleak according to Wilson [1]. A 2014 Gallup Poll found that while 96% of college provosts believe their graduates were ready for the workforce, only 11% of business leaders believed that graduates had the competencies and necessary skills to succeed in the workplace [2]. This lack of preparedness becomes even more of a challenge when students themselves feel they are

prepared for the workforce. A 2015 study conducted by the Association of American Colleges and Universities (AAC&U) found large gaps exist between student and industry perception of student readiness post-college. In some skill areas, even those as critical as oral communication, written communication, creativity, and critical thinking, students ranked themselves more than twice as well-prepared than industry representatives [3]. In this lack of readiness comes a miscommunication of the skillset required to succeed in industry, and that does not exclude the field of engineering.

A year-long immersion program was developed at [[University]] to address this lack of workforce preparedness in college graduates. The Industry Scholars Program, which was industry-initiated in Fall 2016, seeks to infuse students with professional skills early in their undergraduate experience by way of a three-term program that is heavily supported by members of an industry board who provide workshops, site visits, and internships for the students selected for the program. This paper introduces the structure of the Industry Scholars Program, the developed programmatic elements, the internship result, and an evolving mentoring program through discussion of the formation of the program, lessons learned from program directors, and initial feedback from participating students.

Methods

The Industry Scholars Program (ISP) was launched within an NSF-funded Revolutionizing Engineering and Computer Science Departments (RED) Grant at [[University]]. It was one of the goals of this grant to infuse students with professional skills and to enhance the capacity of faculty to help teach those skills. For the purposes of this paper, only the first of these goals is to be discussed. One of the approaches to accomplish this goal was to elicit the help of the engineering school industry advisory board.

The school industry advisory board is comprised of representatives of ten of the region's top companies in engineering consulting, mobility, energy, computing, engineering design, and healthcare; all of which saw an immediate need for the development of the program. After an external briefing on the RED grant in Fall 2016, the advisory board realized the potential for the

program and organically developed the ISP. The industry-led ISP brought together a cohort of first and second year engineering students (n=27), faculty members (n=6), and industry representatives (n=12) to instill professional and leadership skills in future engineers. The skills to be emphasized in the ISP were unanimously identified by the industry board in late Fall 2016 as those needing reinforcement to student learning in the classroom or in some cases, complete introduction to the students. These skills were seen by industry to supplement formal technical skillsets often taught in the engineering classroom based on current industry demands of the professional engineering workplace.

Together the board drafted a mission statement and program objective:
Mission statement*: "The [[School of Engineering]] at the [[University]] proposes to create a professional skills program with our industry partners for first and second year undergraduate engineering students.* First and second year students have a difficult time getting internship opportunities in large part because their engineering skills have not yet been developed. Our industry partners proposed the idea of developing a program where industry could engage with and mentor motivated students in professional and leadership skills in their first two years of their undergraduate studies."
Objective: *"Develop a professional and leadership skills development program with industry partners for first and second year high-performing engineering students"*

The group also composed a list of proposed program outcomes, which will be later assessed, the results of which will be later presented:

(1) Students will be able to describe and discuss expected engineering professional and leadership skills.
(2) Students will demonstrate increased ability in professional and leadership skills.
(3) Students will be able to describe and discuss a variety of engineering related industries and employment types within those industries.
(4) Students will expand their network of industry connections.
(5) Students will have an experience that enhances their resumes and increases their capacity for future employment.

(6) Industry partners will identify potential students that could fit within their organizations and develop a relationship with them before the students reach their junior and senior years of study.
(7) Students will be able to easily transition to internship and employment in junior and senior years.

Prior to launching the program in Spring 2017, the selection process of the students was conducted over the holiday break as a collaborative effort between the industry members and the university administrators and faculty. The dean of the [[School of Engineering]] made a faculty call for student nominations based primarily on faculty identification of student that demonstrated a high level of engagement and with GPA's of at least 3.3. From about 50 nominations, 27 students were selected for participation in the first cohort of ISP.

The first cohort of 27 students included 10 first year students and 17 second year students. First year students at [[University]] do not select a major until their second year. Efforts were made to identify a balanced distribution of student across computer science, electrical engineering, mechanical engineering, industrial and systems engineering, and general engineering. There were also 10 women and 17 men in the student cohort. Note that while 27 students were selected an attended the kickoff and first workshop, only about 18 students attended most of the workshops and stayed with the program.

The year-long program was segmented into three terms: (1) Spring (2) Summer and (3) Fall, all of which contained specific events. The average event lasted 2 hours on a weeknight (apart from industry site visits which were held during business hours and ran for 4 hours (including transportation to and from the industry site), was led by an industry partner, and was always accompanied with dinner that was donated by an industry mentor.

The spring term started with a semester (and program) kickoff event where the students were welcomed to the program by the participating industry and faculty members. All participants were given the book " Stuff You don't Learn in Engineering School: Skills for Success in the Real World [4]. The remainder of the spring term introduced the first cohort of Industry Scholars to professional skills such as teamwork, emotional intelligence, and communication in a series of experiential learning workshops. The two workshops were evenly spaced throughout the semester and were offered on a variety of nights so as to allow for greater flexibility in student attendance. The first workshop was led by an industry member from a local design consulting firm and guided students through the process of identifying traits of good teammates and elements of effective teamwork. This workshop engaged students in an experiential process of "Knowing [Their] Strengths" through a strengths-finders exercise. The second workshop was led by an industry member from a global telecommunications company that presented students with a variety of "skills for success in the real world". This workshop was sub-divided into mini-presentations and an industry panel. The mini-presentations were given by a diverse group of industry board members on three topics: (1) Understanding Yourself and Others, led by a member of the global telecommunications company, (2) Communication, led by an industry member from a transportation company, and (3) Workplace Ethics, led by an industry member from a law practice that focuses on intellectual property disputes. Following the three presentations, an industry panel was held for the students with each of the presenters as well as three other industry board members participating.

The summer term afforded students an opportunity to apply the technical skills acquired in their classes with the professional skills acquired in their spring workshops through an industry sponsored internship. Not all students were offered an internship as there were limited industry partners who were able to offer summer-long internship opportunities. The industry partners received resumes from all of the industry scholars and made selections of who they would hire for the summer internships. Nine internships were offered.

Selected students engaged in their internships for the majority of the summer months, following which time, all students returned for the Fall semester kickoff event. At this opening night, the

students who had engaged in an internship were required to present lessons learned from their experience and reflect on how the ISP impacted their summer professional experience. While not all students engaged in a summer internship program, it was later captured how this internship program might have had an effect on the student learnings from the program. Some students secured internships through direct industry contacts of the ISP, while others secured internships through personal connections.

The third and final term (Fall) of the first ISP cohort aimed to expose students to additional professional skills through similar workshops to those of the Spring term. However, differing from the spring semester, these workshops were held primarily at industry locations to enable tour opportunities and provide students an experiential look at other companies outside that which they experienced during the summer. Four experiences took students to two industry sites and brought two companies into the university to lead an informational workshop on innovations and inventions and an experiential workshop on interviewing skills.

The first of the four experiences was an informational workshop, led by an industry representative engineer and attorney from a global telecommunications company who, introduced students the differences in invention spaces between academia and industry. This speaker discussed intellectual property of his own and addressed student questions regarding their own potential intellectual property. The second experience of the fall term was a site visit to a major transportation company, where students engaged actively in some of the new innovations the company was developing. Several students of the ISP had received internships with this company and took a larger role than their peers in this site visit as they shared with the group hands-on learnings they had been exposed to during their summer. The third experience of the fall term was a skills building workshop, conducted by two industry mentors, both from local design consulting firms. Experiential in nature, this workshop first introduced students to interviewing skills and then required active engagement in mock interviews. Students paired up, and one took on the role of the interviewee while the other was the interviewer. Students practiced two rounds of interviews- the goal of the first interview was to secure a professional mentor, while the second was to secure a summer internship. Students were given prompts to help guide them in their roles. Each round lasted approximately 10 minutes, during which time

the faculty and industry mentors in the room navigated around the room observing and taking note of behaviors and actions to later reflect on as a group. Following each of the two rounds, a large group debrief highlighted some of these behaviors and actions that were noted by the mentors in the room, but also introduced some personal tales and words of advice from the mentors. The final workshop experience of the semester was a site visit to the global telecommunications company from which multiple industry mentors attended ISP events. This tour was also experiential in nature with a large focus on professional etiquette in the industry engineering sector and how that might differ from that experienced in the academic engineering sector.

One final program event concluded the first cohort experience of the ISP. At the program closing event, students were awarded with a certificate of completion of the program, awarded by both academic and industry mentors. This cohort of industry scholars will be matched with industry mentors for the next year as a follow on to the ISP program. Prior to a final dinner with mentors, students also shared takeaways with the mentors in the room verbally but also anonymously provided feedback on the program through the following survey questions (full survey can be seen in Appendix). Student thank-you cards expressed professionalism and deep appreciation of program. Students as well as industry and faculty partners who were present also contributed program feedback on the survey, but skipped the questions that did not apply to their involvement in the program. Questions 3-12 below were conducted using the retrospective pretest-posttest method, a method developed and popularized by Lamb et al and further evaluated by other authors (Lamb & Tschillard, 2005) (Allen & Nimon, 2007). Students were asked to describe their level of understanding, knowledge, skill, or ability of the question topic both before and after the workshop on a scale from 1-5, where 1 was “None”, 2 was “Little”, 3 was “Moderate”, 4 was “Quite a bit”, and 5 was “Complete”.

(1) Which role best describes you? (Student/Faculty/Industry Partner/Other)
(2) If you are a student, designate what year you are in your academic studies: (First year/Second year/Third year/Fourth year/Fifth year)
(3) My ability to describe and discuss expected engineering professional skills.
(4) My ability to describe and discuss expected engineering leadership skills.

(5) My self-awareness.
(6) My effectiveness at communication.
(7) My ability to interview.
(8) My awareness of business ethics.
(9) My ability to describe and discuss a variety of engineering related industries and employment types.
(10) My industry connections.
(11) The quality of my resume/CV.
(12) My access to students, faculty, and industry partners.

The following questions were grouped in a table to assess the level of participation throughout the year-long program. Those who completed the survey were asked to indicate if they did or did not attend/engage in the listed experience, or if they did not remember. The following events were listed:

(1) Spring 2017 Kick-off Event
(2) Know Your Strengths Workshop
(3) Emotional Intelligence Workshop
(4) Industry-desired skills Workshop
(5) Summer internship
(6) Fall 2017 Kick-off Event
(7) Innovations and Inventions
(8) Cubic Transportation Tour and Program
(9) Interviewing Skills Building Workshop
(10) Qualcomm Tour and Program
(11) Industry Scholars End of Semester Celebration

One optional question following this series of attendance questions: "If you did engage in a summer internship, was it secured (circle one): through the Industry Scholars Program/outside of the Industry Scholars Program"

Two final short answer questions were asked:

(1) How has the Industry Scholars Program impacted your professional experience and goals thereof?
(2) What other comments/recommendations/points of feedback might you desire to share with the Industry Scholars Program planning committee?

The results of these surveys were analyzed by a third-party company that specializes in program evaluations. The results from the post-pre-post portion of the survey were analyzed using a two-tailed T-test and Cohen's Effect Size. All attendance responses were compiled into percentages and short answer questions were documented but not further coded. Examples of short answer responses as well as compiled results from this survey will be shared in the Results and Discussion.

Results and discussion

A total of 22 surveys were completed on the final event of Cohort I of ISP. It should be noted that not all students who participated in the program were in attendance at the final event and therefore might skew the results. Approximately 75% (15) of respondents were students (33% in their second year (started the ISP in their first academic year) and 67% in their third year (started the ISP in their second academic year)), 10% (2) were faculty mentors, and another 15% (3) were industry partners. Two respondents skipped this question and were not included in these percentages.

The surveys of the 15 students were compiled and further analyzed in Table 1 below.

Table 1: Compilation of average responses for each of the survey questions inquiring about growth in understanding, knowledge, skill, or ability.

All students, n=15 **Responses: None=1, Little=2, Moderate=3, Quite a bit=4, Complete=5**

Describe your level of understanding, knowledge, skill, or ability of the following:	My Understanding, Knowledge, Skill, or Ability						Results	
	BEFORE the Workshop			AFTER the workshop			T value, df, Sig lvl (2-tailed)	Cohen's d, Effect Size
	MEAN	SD	N	MEAN	SD	N		
Q4&5. My ability to describe and discuss expected engineering professional skills.	2.73	.593	15	4.00	.488	15	7.48, 14, .000	Cohen's d=3.99, ES r=.89 (large)
Q6&7. My ability to describe and discuss expected engineering leadership skills.	2.60	.632	15	4.27	.458	15	7.91, 14, .000	Cohen's d=4.23, ES r=.90 (large)
Q8&9. My self-awareness.	3.67	.817	15	4.40	.632	15	3.21, 14, .006	Cohen's d=1.72, ES r=.65 (medium)
Q10&11. My effectiveness at communication.	3.33	.617	15	4.27	.593	15	5.14, 14, .000	Cohen's d=2.75, ES r=.81 (large)
Q12&13My ability to interview.	2.60	.828	15	4.07	.799	15	6.81, 14, .000	Cohen's d=3.64, ES r=.88 (large)
Q14&15. My awareness of business ethics.	2.60	.828	15	4.00	.655	15	4.84, 14, .000	Cohen's d=2.59, ES r=.79 (large)
Q16&17. My ability to describe and discuss a variety of engineering related industries and employment types.	2.60	.632	15	4.13	.915	15	6.49, 14, .000	Cohen's d=3.47, ES r=.87 (large)
Q18&19. My industry connections.	1.87	.834	15	4.00	.756	15	7.79, 14, .000	Cohen's d=4.16, ES r=.90 (large)
Q20&21. The quality of my resume/CV.	2.87	.834	15	4.33	.488	15	5.74, 14, .000	Cohen's d=3.07, ES r=.84 (large)
Q22&23. My access to students, faculty and industry partners.	2.40	.737	15	4.67	.516	15	7.75, 14, .000	Cohen's d=4.14, ES r=.90 (large)

It can be seen that all areas saw significant growth in understanding, knowledge, or skill. The two areas with the largest growth were those directly associated with industry connections, with "my access to students, faculty, and industry partners" seeing a mean growth of 2.27 and "my industry connections" seeing a mean growth of 2.13. The next areas that saw the greatest growth were also similarly related to engineering skillsets, with "my ability to describe and discuss expected engineering and leadership skills" increasing by an average of 1.67 and "my ability to describe and discuss a variety of engineering related industries and employment types" increasing by an average of 1.53. The two questions related directly to skillsets/tools for moving into this industry engineering position saw the next largest growth and were nearly identical in their change: "my ability to interview" rose 1.47 while "the quality of my resume/CV" rose 1.46. The two categories that increased the least, while still significant, were those most clearly connected to social skillsets: "my self-awareness" rose only 0.73 and "my effectiveness at communication" rose only 0.94. However, while there is clear groupings of average increases in this data, what can be largely taken forward is the significant growth that was seen in all areas that were measured. While impressive, these increases could be due to experiences outside the ISP, so these results should be directly compared to the attendance throughout the program.

All respondents (n=22, students=15, faculty=2, industry partner=3, other (no answer)=2) were included in the evaluation of participation throughout out the program (Table 2).

Table 2: Documentation of the attendance at each event during the 2017 Industry Scholars Program Cohort I.

All respondents: n=22, Students=15, Faculty=2, Industry Partners=3, Other (or no answer)=2

Question 24: Indicate your attendance at the following ISP experiences	I did attend/I did engage in the experience	I did NOT attend/I did NOT engage in the experience	I don't remember	Total
Cubic Transportation Tour and Program	52.38% 11	47.62% 10	0.00% 0	21
Emotional Intelligence Workshop	85.00% 17	5.00% 1	10.00% 2	20
Fall 2017 Kick-off Event	90.91% 20	9.09% 2	0.00% 0	22
Industry Scholars End of Semester Celebration	95.24% 20	4.76% 1	0.00% 0	21
Industry-desired skills Workshop	90.00% 18	10.00% 2	0.00% 0	20
Innovations and Inventions Roger Martin, Qualcomm	90.48% 19	9.52% 2	0.00% 0	21
Interviewing Skills Building Workshop	65.00% 13	35.00% 7	0.00% 0	20
Know Your Strengths Workshop	90.48% 19	9.52% 2	0.00% 0	21
Qualcomm Tour and Program	75.00% 15	25.00% 5	0.00% 0	20
Spring 2017 Kick-off Event	95.24% 20	4.76% 1	0.00% 0	21
Summer internship	45.00% 9	55.00% 11	0.00% 0	20

In only 2 instances did respondents not recall the particular event and, in both cases, it was the Emotional Intelligence Workshop. All other events saw significant contribution and engagement with the exception of two events: (1) Cubic Transportation Tour and Program (52.38% did attend/47.62% did not attend) and (2) Summer internship (45.00% did attend/55.00% did not attend). Even though 55% of the respondents did not receive an internship in the summer, it is clear that this did not stop their particular participation in the program the following fall term for

three of the four experiences that were offered: (Innovations and Inventions (90.48% did attend/9.52% did not attend), Interviewing Skills Building Workshop (65.00% did attend/35.00% did not attend), Qualcomm Tour and Program (75.00% did attend/25.00% did not attend)) in addition to the Fall 2017 Kick-off event (95.24% did attend/4.76% did not attend)). It is noted that two of the three least attended events were industry site tours (Cubic and Qualcomm). A variety of reasons might attribute to this attendance, including that the chosen times for both of these visits was a Friday afternoon that better suited industry's schedules, but did not necessarily align well with most students' school schedules. Future scheduling conflicts will be addressed in the early portion of the program to allow for more coordinated events.

All survey respondents participated in the short answer questions, the first of which asked, "How has the Industry Scholars Program impacted your professional experience and goals thereof?" A few student responses to highlight are as follows:

"It has made me much more aware of what is expected and desired in the engineering field of new engineers, and has helped me further my opportunities and personal growth."

"It has taught me a lot about what direction I would like to take my career and academic life to potentially succeed in a professional setting."

"The skills I learned in the program directly applied to my internship and helped me feel more prepared for my participation in industry."

"It helped me get an internship the summer after my second year which I wouldn't have gotten otherwise. Greatly increased my professional experience."

"The ISP has made me more ready for the professional world in every sense. I feel more confident communicating and navigating the professional world."

"The ISP has significantly impacted both my professional experience and goals… After having completed this program, I not only developed a network for advice, the numerous workshops and speakers made me realize the diversity of what it means to be an engineer."

Collectively, students felt the program benefitted them in their current academic navigation towards an engineering career as well as prepared them professionally for what was next, giving them insight into what that path might be and how diverse it actually is. Industry and faculty responses also saw positive impact of the ISP:

"As a professional who supports students, I have learned so much from industry. Hiring, interview tips, professionalism as an engineer. This has been great." (faculty)

The last grouping of short answers made recommendations for future iterations of the program in asking, "What other comments/recommendations/points of feedback might you desire to share with the Industry Scholars Program planning committee?" Some select responses are below:

"My favorite part of the program was touring the various plants and I would have loved to do more."

"More discussion with the partners."

"This was a valuable experience because I got to see what engineering means in the real world, beyond the classroom. Recommend stay[ing] relatively small and intimate."

"Greater student attendance. We need to address why attendance diminished over the duration of the course. Did the course lose value to the students or was it a lack of time or other?" (industry partner)

This final comment regarding attendance diminishing should be noted and is currently being looked into by the program directors. It was seen that over the course of the program, attendance decreased from full participation at the start of n=27 to a final attendance of n=15 students at the final program conclusion. Future iterations will take into the account the information that is gained from upcoming student focus groups and additional surveys of those whose attendance decreased over the year. It is hypothesized that this decrease in attendance correlated with those who did not receive internships, and these students had expected an internship as a part of the ISP. This will be addressed in future cohorts, as summer internships will be provided for all participants and will be communicated at the start of each spring term.

While survey respondents presented feedback for future programming, the program planning committee also compiled a list of lessons learned post the first pilot ISP conclusion. Several logistical lessons were experimented during the first cohort: Clear roles and expectations were not communicated at the start of Cohort I of ISP. Therefore, expectations for commitment and completion of the program will be more clearly communicated at the start of the program for all involved parties (students, faculty, and industry partners). For both industry and faculty

members, clear roles will be established and communicated to all the respective parties. To assist with improved attendance by all, a semester schedule will be proposed and agreed upon by both industry and academic partners, paying careful attention to academic holidays/schedules. Additionally, this semester schedule will be provided to the students at the start of each semester to allow for more time to plan accordingly. One role that was required but often filled by several people ad hoc was that of the point program person—the point of contact for students to ask questions regarding events or for space set-up. The tasks associated with this role will be more clearly divided and assigned to several people in future iterations. One role that will be created is that of career development liaison—it was observed that throughout this process, students found themselves grappling with career/professional questions in between ISP events.

In the first cohort of ISP, students were not asked to engage with the experiences for any length of time beyond that which they were present for. Reflection opportunities post workshop/site visit will be utilized in the future as another means to track the progress of the students to ensure that what they are being exposed to is reaching them at a deeper level of professional integration. Finally, the student selection process will be altered to first, include only students in their second year, but also will require more than just a faculty recommendation. Each student that is nominated by a faculty member (based on adjusted requirements) will be required to submit an application detailing their interest in the program and larger professional goals they might have. These applications will be reviewed by a committee of faculty and industry members as a second screening of possible participants in the program to ensure diversity as the program grows in popularity.

Summary

The Industry Scholars Program piloted successfully its first cohort of students in the year 2017. Driven by industry professionals and guided by industry needs, the program obtained its objective (to develop a professional and leadership skills development program with industry partners for first and second year high-performing engineering students) and achieved all of its program goals as documented by the level of significance of final responses of student growth.

The results show an industry-university program can be utilized as a national model for an industry-driven professional and leadership skills development program for engineering students.

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