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To Infinity and Beyond: Boosting URM Students' Career Trajectories Through Professional Experiences

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Abstract

It is hard to deny the impact of experiential learning through internships on engineering education. Likewise, students may also benefit from professional experiences that are not traditional internships. From shadowing, to full-blown hands-on internships, experiential learning provides students with the ability to see application of theory beyond classrooms, to learn to efficiently practice their art, develop transferable skills, and add further value to their academic career.

Engineering educators, and engineering industry leaders, have long recognized the value of and the need for "practice ready" graduates. Today, as the world grapples with the work-from-home and social distancing guidelines necessary to slow the spread of COVID-19; we are in need of "practice ready" graduates more than ever before. The degree to which engineering graduates are prepared to perform on the job can be further improved by establishing strong and effective college-industry partnerships that develop meaningful and diverse professional experiences. The value of these experiences, resultant of strong college-industry partnerships, include but are not limited to: refining and expanding students' professional identity, practice readiness, and improving resilience.

In this paper, we considered professional experiences from the students' perspective. The data were collected by conducting an online survey of all engineering students in the College of Engineering, Informatics, and Applied Sciences at Northern Arizona University. The survey was scoped to identify the plethora of current experiences of students, explore related major duties and responsibilities, and self reported holistic competencies. This paper investigated to what extent these experiences shaped students' professional identities, practice readiness, and motivated them to persevere through their studies. The findings of this work close-the-loop, and can be utilized to improve the activities of engineering career development offices across the world.

Introduction

Internships have long been recognized as valuable by students, employers, and career services professionals aiding job search, recruiting, and career development [1].

> *"For students and career services professionals, internships offer a range of benefits, including the opportunity to identify and clarify career direction, develop skills important to career readiness, and gain first-hand experience in the workplace. For employers, internships can serve as a valuable source of new hires, enabling the organization and potential hire to try each other out, thereby enhancing retention down the road as well. [1]"*

Here we argue that it is not only internships, but also professional experiences including non-technical or those unrelated to one's major that provide value for students' career readiness. In this study, professional experiences were inclusive of working for an organization in a position related or unrelated to one's major (paid or volunteer); doing research in a position related or unrelated to one's major (paid or volunteer); and other personal experiences, like camps (summer or any other time of year); sports teams, practice, competitions; art and/or music lessons and practice; religious studies; or self-taught skills such as learning computer coding, flying drones, fixing a car, woodworking, etc.

Experiences guide who we are, both in terms of personal identity and in terms of preparation for the future workplace. In other words, we can think of readiness as a state of preparation [2], a competency, which includes both emotional and physical aspects [3]. Consequently, work readiness is a measure of one's ability to complete assignments in accordance with the provisions, without experiencing major setbacks, to provide maximum results [3]. In this paper, we will refer to this work readiness, as practice readiness by placing an emphasis on "practicing" engineering, from a holistic perspective.

Literature Review

Areas of research literature relevant to this study include the topics of: the need for practice ready graduates, discrepancies between industry expectations and students' practice readiness, and standard instruments to measure students' practice readiness.

The need for practice ready graduates

To ensure international competitiveness in today's knowledge-based economy, all stakeholders expect university graduates to be "practice ready" [4]. To this end, since the 1970s, ABET has emphasized the student Outcomes (Criterion 3), which are expected to prepare graduates to seamlessly enter into the professional practice of engineering. ABET student outcomes are organized into seven dimensions. Most professors agree that these are important for engineering graduates [5]. Four of these dimensions are directly assessed here: problem solving (1); problem solving in a global, environmental, and societal context (2), effective communication (3), ethical responsibilities (4), teamwork and leadership (5), and the ability to acquire and apply new knowledge (7).

In Hugo's 2010 review of "Educating Engineers - Designing for the Future of the Field by Shepherd et al. (2009)" it is argued that there is a disconnect between engineering education and practice [6]. There has been a slow transformation of engineering education in response to profound evolution within the engineering profession, which has proved insufficient to prepare engineering students to deal with the challenges that current engineering practice demands. They urged a focus on professional practice within undergraduate engineering education curricula and a move away from the traditional curriculum (i.e. linear, deductive, structured one-right answer problems) to open-ended scenarios and experiences [6].

Several studies have articulated employer expectations for engineering graduates; practice ready graduates are more likely to have higher potential job performance, success, promotion, and career advancement [7, 8].

To add to this, the unexpected impact of the pandemic, and drastic shift to work from home, requires these new graduates to be practice ready more than ever before.

The discrepancy between industry expectations and students' practice readiness

Engineering student placement experience is recognized as increasingly important in their pre-employment education [9]. Why? The transition from senior year at a university into the workforce is a critical time for graduates, especially those with limited previous work experience [10]. The workplace reality requires students to not only have strong academics, but also be equipped with skills and perspectives typically gained outside of academic settings [3].

The concerns about discrepancy between the industry expectations and graduate practice readiness has been alluded to for general engineering [6], studied within software engineering [11], civil engineering [10], and chemical engineering graduates [12].

Literature has shown that there are a number of approaches higher education institutions have taken to improve their graduates' practice readiness, some of which have enhanced students' employability through developing generic skills or holistic competencies [4]. Additionally, some institutions have implemented capstone design classes, in an effort to meet ABET criteria on student outcomes and address concerns regarding graduates ill-prepared for industrial practice [5, 13].

To enhance students' employability skills, career identity and practice readiness; Green, Carbone, and Rayner (2019) argued for more flexible and accessible alternatives to the traditional curriculum [14]. Carbone et al. (2020) identified a range of programs and practices, in addition to placements and internships, including practicums, projects, field trips, and site visits within the plethora of activities that can be used to develop practice ready graduates by expanding students' perceptions of their career and professional identity [13].

Another example of flexible and accessible alternatives is student organizations. Kurniawaran et al. (2020) argued the positive and significant impact of students' involvement in organizations on work readiness [3]. In addition to providing training to work within multidisciplinary teams, active organizations help students foster an independent attitude, confidence, discipline and responsibility, improve time management skills, improve communication skills, expand their networks, develop insight, increase awareness and sensitivity to the community and to the environment, and foster critical, productive, creative, and innovative abilities (Kurniawan and Puspitaningtyas (2013) in [3]), [15].

Standard Instruments of "Practice Readiness" and their Limitations

Little is known about how well prepared final-year engineering students perceive themselves to enter the workforce [10]. There is increasingly recognizable value in identifying an instrument to measure student practice readiness. The level of graduate readiness for practice has been studied for medicine [16], nursing [17, 18], finance and accounting [19]; and economics [3]. There are numerous sample internship exit interview surveys available online [20-22]. Although these instruments might give insight into participants' practice readiness, they have not been validated; therefore their reliability is questionable.

Prikshat et al. (2019) stated that there is no uniform scale for accurately documenting graduate work-readiness within the context of escalating and changing needs in education and practice. They reviewed several existing graduate work-readiness and skill assessment instruments, and concluded that some lack to assess the personal attributes and personality traits, which may be associated with generic skills graduates are expected to possess [23]. They then measured work-readiness of the graduates, who are seeking their first full-time job in industry, with an integrated competencies model for Asia-Pacific specific region [23].

O'Brien et al. (2012) looked at final year civil engineering students in Melbourne, Australia by including 9 dimensions, engineering fundamentals: knowledge, analysis, and design; modern tool usage; engineering responsibility to society and environment; ethics; individual and teamwork; communication; project management and finance; as well as lifelong learning; and coping skills. The survey included 52 items, on a 6-point scale ranking their responses with respect to how well their degree had prepared them in relation to each specific topic: from "very inadequately" to "very adequately". Their sample size consisted of 19 responses [10].

The study by Male et al. (2011) derived a statistical 11-factor generic engineering competency model by comparing experienced engineer's perspectives to the industry leaders' in Australia. The resulting model included communication, teamwork, self-management, professionalism, ingenuity, management and leadership, engineering business, practical engineering, entrepreneurship, professional responsibilities in addition to applying technical theory [24]. The teaching methods and learning opportunities that develop these generic competencies within an engineering framework are recommended for engineering students to prepare for practice [24].

The studies mentioned above were either country specific, not engineering, or discipline specific with limited sample size [3, 10, 16-19, 23, 24]. Some of these studies employed a comprehensive instrument [10, 23], for which survey fatigue is known to be a problem. The scales presented above have the potential to systematically measure practice readiness, but they suffer from some limitations. There is a need to further validate a generic "practice-readiness" scale, applicable to all disciplines through a lens of an inclusive definition of "professional experiences".

Based on this previous literature, we have identified that future work investigating this connection between professional learning and student practice readiness should make use of a validated scale. Chan and Luk (2020) have developed and validated such a scale ($N > 2000$

undergraduate students) and have agreed to provide their full survey for use in this study. We took this one step further, as we also explored underrepresented (gender and URM) students' perspectives and experiences.

Methodology

Students from multiple disciplines in engineering and applied sciences within the college were surveyed online and asked to identify their experiences. The participants were recruited using a college-wide all-student Listserv, and also delivered by the authors, in their respective classes. Total of 282 students started the survey, however 180 respondents completed its entirety. The survey asked students to self-identify their program of study, how many semesters left to graduate, their experiences, job duties, professional identity, resilience and finally, holistic competencies as identified by Chan et al. (2017) and validated by Chan and Luk (2020). Participants provided short answers for some questions, selected responses using a five-point likert scale that ranged from "Strongly Disagree" to "Strongly Agree"; "Not at All Confident" to "Very Confident"; or "Very Poor" to "Very Good." All analyses were done within Matlab R2020b, leveraging built in functions for comparisons and regression.

Chan and Luk (2020) argued that questions pertaining to demographic information prior to the evaluation items may draw participants' attention to stereotypes and their awareness of minorities. In order to eliminate bias, we omitted demographic information questions from the survey, but did request the respondent's email. This was then used to match the student's survey responses to institutional records of gender and race/ethnicity [25]. The team was composed of two faculty members with the college career development professional. The career development professional managed all data collection, matching of demographics to responses, and data de-identification before sharing any of this data with the faculty members to perform the analysis.

Analysis revealed that out of the 180 complete responses, 63 (35%) were female and 117 (65%) were male. See Table 1 for demographics, including race/ethnicity and gender comparing our study cohort to the whole college; relative percentage of each is similar.

This study sought to answer the following research questions (RQ):

1. *To what extent do students feel they possess the holistic competencies to be practice ready?*

    1.a. Does the self-reported level of practice readiness correlate with how many semesters are left before graduation?

    1.b. To what extent do professional experiences impact students' practice readiness?

    1.c. Does the self-reported level of the practice readiness differ across various professional experiences? Which experience is the most impactful?

2. *To what extent do professional experiences influence students' professional identity?*

3. *How do RQ1 and RQ2 differ for underrepresented student groups (gender and URM)?*

Table 1: Distribution of race/ethnicity and gender within the study and within the college.

	Study Cohort		College	
Race / Ethnicity	*Number*	*Percentage*	*Number*	*Percentage*
White	107	59%	1246	54%
Hispanic / Latin x	36	20%	459	20%
Two or More	11	6%	139	6%
International	8	4%	241	10%
Asian	7	4%	57	2%
American Indian / Alaska Native	6	3%	80	3%
Black / African American	4	2%	49	2%
Not Specified	1	1%	40	2%
Hawaiian / Pacific Islander	0	0%	12	1%
Gender	*Number*	*Percentage*	*Number*	*Percentage*
Female	63	35%	487	21%
Male	117	65%	1836	79%

Data Analysis and Results

Table 1 shows the distribution of our study cohort as compared to the overall college both in terms of ethnicity and gender. The fractional representation of ethnicity and gender in our study cohort is similar to the overall college. Given this similarity, we can expect our analysis to be representative of the college, and findings to then be applicable to the college.

To answer RQ1: To what extent do students feel they possess the holistic competencies to be practice ready. We analyzed the mean and standard deviation for all competencies listed by Chan et al. (2017) as shown in Table 2. There are 27 competencies listed under question #14 of the survey. The full survey is included in the Appendix.

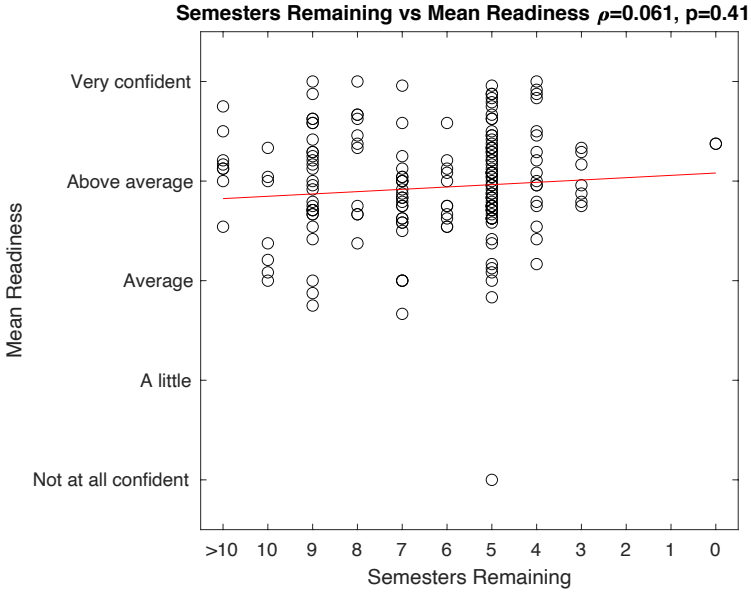

Figure 1: Shown here are the per student mean readiness (*y-axis*) vs the number of semesters remaining (*x-axis*), indicated by each circle. The read lines shows a first order regression model to fit the data. This regression shows a positive trend, though data from students with two or three semesters remaining was limited.

Table 2: Mean and standard deviation of student respondent self evaluations on 5 point likert scale of confidence for each holistic competency question. Here, 1 is "Not at all confident," 3 is "Average," 5 is "Very confident."

Mean Response	Standard Deviation	Question
3.406	1.102	Self-confidence
3.472	0.868	Persuade others
3.683	0.936	Have information technology skills
3.767	0.992	Build and maintain relationships
3.728	0.927	Motivate others
3.817	0.972	Lead others
3.844	0.991	Understand your own culture
3.856	0.992	Be able to develop clear goals, self-direction, and self-discipline
3.889	0.804	Express and receive ideas clearly
3.889	0.776	Have the ability to effectively find, evaluate, and use information
3.894	0.948	Be responsible for team members
3.978	0.871	Communicate with others effectively in different contexts
4.011	0.997	Have a sense of citizenship and responsibility to contribute to the society
4.011	0.891	Be aware of personal strengths and weaknesses
4.044	0.775	Analyze and evaluate an issue
4.072	0.812	Have numerical skills
4.111	0.915	Be aware of ethical responsibility
4.139	0.746	Identify problems
4.189	0.775	Think critically
4.278	0.819	Appreciation for others
4.278	0.777	Be reliable
4.294	0.789	Consideration for others
4.322	0.816	Understand and respect other cultures and perspectives
4.378	0.853	Respect individual differences and preferences

We calculated the mean response, and the standard deviation, then listed the mean for each holistic competency from lowest to highest (Table 2). The students report that they are most considerate of others, understand and respect other cultures and perspectives, and respect individual differences and preferences.

The next question we sought to answer was "RQ1a: Does the self-reported level of practice readiness correlate with how many semesters are left before graduation?" To do this, we regressed the overall mean readiness of an individual's mean response to all questions, against the number of semesters remaining. We have reported the fit ($\rho = 0.061$). Figure 1 shows the mean readiness across the number of the semesters left. As shown on Figure 1, as the number of semesters remaining decreases (close to graduation), the overall readiness increases. This correlation is small, and not statistically significant, yet there appears to be a small positive gain towards graduation moving the line above average readiness. Additional connection was observed when RQ1b was explored. As Table 3 reflects, there appears to be a strong correlation ($\rho = 0.913$, $p = 0.087$) between the mean readiness response and the number of professional experiences a student has. A t-test was used to compare overall (mean) readiness of the students

who had no professional experiences to the group of students who had one or more experiences ($p = 0.236$, $t = 1.189$, $df = 280$).

RQ1c explored "Does the self-reported level of the practice readiness differ across various professional experiences? Which experience is the most impactful?" A total of 498 experiences were reported for this question on the survey from a total of 282 respondents. The analysis of RQ1b was repeated for the mean readiness according to type of experience. Table 4 shows 66 students reported having none of the professional experiences listed in the survey, 139 reported exactly one, 55 reported exactly two, 19 reported exactly three, 2 reported exactly four and 1 reported exactly five professional experiences, Table 5 shows the clear difference between students with no experience (3.786 ± 1.001) versus some experience.

Table 3: Mean and standard deviation of aggregate student response to self evaluations of holistic competency questions, grouped by the number of experiences.

Mean Response	Standard Deviation	N	Experience (grouped to number of experiences)	
3.786	1.001	66	No Professional Experiences	} $p = 0.236$, $t = 1.189$, $df = 280$
3.920	0.736	216	One or More Professional Experiences	
3.879	0.732	139	1 Professional Experience	
3.923	0.796	55	2 Professional Experiences	
4.273	0.467	19	3 Professional Experiences	
4.000	1.414	2	4 Professional Experiences	

Table 4: Mean and standard deviation of aggregate student response to self evaluations of holistic competency questions, grouped by the type of experiences.

Mean Response	Standard Deviation	N	Experience (grouped to number of experiences)
3.786	1.001	66	None of these experiences
4.016	0.745	115	Worked for an organization (paid or not) : *Related to major or not* *
4.100	0.712	66	Worked for an organization in a position related to my major
4.000	0.756	66	Worked for an organization in a position NOT related to my major
4.000	0.866	38	Did research (paid or not) : *Related to major or not* *
4.000	0.926	31	Did research in a position related to my major
3.667	0.577	10	Did research in a position NOT related to my major
3.911	0.709	146	Personal experiences, like Camp (any other time of year)

* : aggregate measures that combined the responses to both "related to my major" and "NOT related to my major."

Table 5: Mean and standard deviation of aggregate student response to self evaluations of professional identity, grouped by the number of experiences. As can be seen here, there exists a statistically significant difference between the No Prof. Exp. and the One or More Prof. Exp. groups; $p = 0.004$.

Mean Response	Standard Deviation	N	Experience (grouped to number of experiences)	
3.349	0.948	66	No Professional Experiences	} $p = 0.004$, $t = 2.870$, $df = 280$
3.768	1.063	216	One or More Professional Experiences	
3.696	1.051	139	1 Professional Experience	
4.000	1.000	55	2 Professional Experiences	
3.636	1.286	19	3 Professional Experiences	

To answer RQ2, “To what extent do professional experiences influence students' professional identity?”, both qualitative and quantitative data were analyzed. We qualitatively grouped responses into themes and categories and have reported the frequency distribution of these response types. We also applied quantitative methods, descriptive and t-test, to analyze student confidence (instead of preparedness).

Students provided responses to the prompt “Give a brief description of the experiences you have found most influential in your career choice(s).” Participants were able to respond to this question up to four times if they had or wanted to list more than one experience. The maximum response count was 171 for the first experience listed, which can be argued as possibly the most impactful experience on students' professional identity.

The responses for the prompt were analyzed using thematic analysis [26]. A single coder initially conducted the analysis of the responses, starting with a set of a priori codes that came from the development team’s vision of the survey. Codes were categorized by student responses with a focus on diverse professional experiences listed. As the analysis progressed, initial codes were modified, condensed and new codes emerged to better capture students’ professional experiences. A second coder then confirmed codes, and later the team came to a consensus on final codes, themes and categories (Table 6). The frequency distribution of the categories is shown in Figure 2. According to the student responses, the most influential experiences students have, are in the category of preparation. To validate the accuracy of research findings, the researcher employed two strategies recommended by Creswell [27]: peer debriefing (discussions with the team during data collection and analysis) and consideration of discrepant information that ran counter to the themes. The data was continually reexamined during analysis as patterns and themes emerged [28].

For RQ2, the quantitative analysis depends on “How confident are you that you are on the right track for your desired future career?” question in the survey. Responses were coded according to a 5 point Likert scale (1:not at all, 2:a little,3: average, 4:above average, 5:to a great extent). The data is analyzed across the number of the semesters before graduation, and the type of professional experience reported. Table 5 shows the Mean Self-assessed Professional Identity.

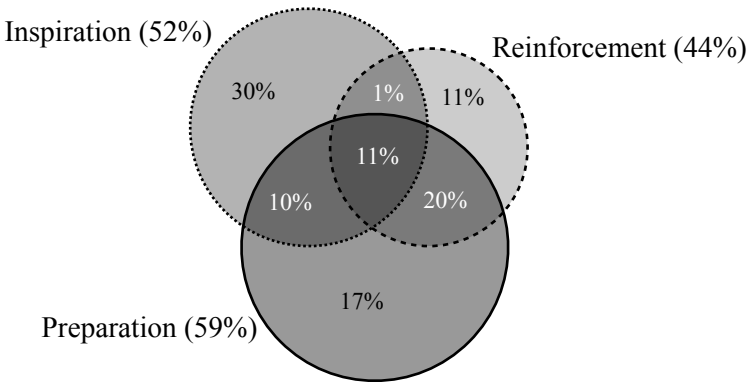

Figure 2: Shown here are the responses to the question “ Give a brief description of the experiences you have found most influential in your career choice(s).” The emerged categories, and their relative occurrences, are reflected in this Venn diagram.

Table 6: Codes and themes emerging from participants' experiences they found most influential in their career choices. One can see the set of codes is quite diverse.

Category	Codes and Subcodes	Themes
Reinforcement	Personal Counseling Luck and Opportunity Teachers Parents, Family members	Encouragement
Reinforcement & Preparation	Class and Teacher Engineering/Astronomy Summer Camp Competition-Robotics	Encouragement Supported with Preparation
Preparation	Teaching Assistant for a Class Shadowing Repair Jobs Hands on Work	Major Related Work
	Navy, NREIP NJROTC	Military Experience
	Research	Research
	Athletics Boy Scouts	Extracurricular Activity
Preparation & Inspiration	Fixing Cars Restoration on Cars Worked on Engines Sustainability and Conservation Service Trip Competitive Motorsports	Working in a Supported Environment Towards a Purpose
Inspiration	Working for a Cause Working for an Non-Governmental Organization	Non-Major Related Work
	Volunteer Work Missionary Work Service Trip	Service
	Hobby Building Something, Legos Video Games Riding Roller Coasters Puzzles Travel Visiting Institutional Centers (e.g. Congress) International Travel Experience Love of the Outdoors Camps	Personal Interest
	Negative Experience Disability	Significant Negative Event/Experience
Inspiration & Reinforcement	Observation of the Real World Work Taking an Interest Survey	Introspection
Reinforcement, Preparation, & Inspiration	Hands on Engineering School/Camp Related Activity Internship at an Engineering Firm Repairs with Family Support Being Part of Society of Women Engineers	Scaffolded

In RQ3, we further sought to investigate the findings for RQ1 and RQ2 by cross analyzing students' underrepresentation (URM) status and gender descriptors. We described the incidence of experiences as dichotomized by gender and URM status. We then performed a t-test for each paired group, paired by gender and URM status. Results of the gender analysis are reflected in Table 7; results of the URM analysis are not included because no statistically significant difference was found.

Table 7: Shown in this table are the mean, and standard deviations of readiness for each group, male and female, in sum and separated into No Prof. Exp. and Some Prof. Exp. groups. Between each set of means and standard deviations, are the t-test results of those comparisons. All paired comparisons were found not to be significant, except the paired comparison of males with some professional experience and females with some professional experience. This demonstrates that the impact of those experiences on female students is significant.

Male				**Female**
All (117)	3.927 ± 0.590	$p = 0.128$, $t = 1.527$, $df = 178$	4.058 ± 0.450	**All (63)**
No Prof. Exp. (26)	3.946 ± 0.799	$p = 0.798$, $t = 0.257$, $df = 40$	3.888 ± 0.509	**No Prof. Exp. (16)**
	$p = 0.860$, $t = 0.177$, $df = 115$		$p = 0.081$, $t = 1.775$, $df = 61$	
Some Prof. Exp. (91, 77.8%)	3.922 ± 0.521	$p = 0.030$, $t = 2.199$, $df = 136$	4.115 ± 0.418	**Some Prof. Exp. (47, 74.6%)**

† 3 students provided no email, no gender could be identified for them.

Discussion

Our results show the interrelatedness of student practice readiness, holistic competencies, professional experience type, the number of experiences, and number of semesters before graduation (RQ1).

The mean scores of self-reported individual holistic competencies ranged from 3.406 ± 1.102 (Self Confidence) to 4.378 ± 0.853 (Respect individual differences and preferences). The top three competencies included the following: (1) Respect individual differences and preferences (4.378 ± 0.853); (2) Understand and respect other cultures and perspectives (4.322 ± 0.816); (3) Consideration for others (4.294 ± 0.789); see Table 2.

As one would expect, the overall readiness of the participants appeared to increase as the number of the semesters left to graduate decreased. However, this finding could be limited by the small sample size, especially given the absence of representation from students with one or two semesters remaining.

Students having no professional experience reported the lowest mean readiness (3.786 ± 1.001). Professional experiences do prepare students for the job (practice readiness), and increas their self confidence (reported by the mean readiness). The impact is even greater when students move from having two professional experiences (3.923 ± 0.7896) to three professional experiences (4.273 ± 0.467), they become closer to being "very confident"; see Table 3.

The mean readiness scores reported by students with different experiences showed small differences amongst professional experiences. Among the students who had professional experiences, the highest mean readiness was reported by the students, who worked for an organization (paid or volunteer) in a position related to their major. Doing research (paid or volunteer) in a position not related to one's major seems to be the least helpful in building practice readiness. This analysis also revealed that among the respondents to the survey, students doing research (paid or volunteer) is the minority group (N = 10 vs N = 31 to 146); see Table 4.

The next question (RQ2) explores how one's professional identity connects to the professional experiences they have had. The single most common response was fixing or working on cars. Open ended responses indicated the distribution of professional experiences across categories; we see Preparation experiences were reported as most overall impactful (59% total) on one's professional identity, followed closely by Inspiration (52%), and finally Reinforcement (44%) experiences. However, Inspiration was listed as the most common single factor of these experiences, which impacted students' professional identities (30%). See Figure 2. Further, as shown in Table 6, there is a very eclectic set of experiences that leads a person to an engineering career.

In our study cohort, having two professional experiences produced the highest mean confidence (4.00 ± 1.0, N = 55). It is valuable to note though that the sample size for having three professional experiences is relatively small, consisting of only 10 respondents, which may be impacting the drop on the mean. Although there is a medium correlation between the number of professional experiences and the professional identity, it is not statistically significant ($\rho = 0.564$, $p = 0.436$).

When data was examined across for students with no experience (3.349 ± 0.948, N = 66) versus students with some experience (3.768 ± 1.063, N = 216), revealed $p = 0.004$, $t = 2.870$, $df = 280$. Having "a professional experience" whether it is paid, or volunteer, research or internship, related to major or not, has a statistically significant impact on one's professional identity as compared to students with no such experiences.

Using the lenses of URM status and of gender, our findings were in alignment with what we had expected, but the magnitude of these effects was smaller than anticipated. When we considered who has had one or more of these professional experiences, we found that 72% of URM students and 79% of non-URM (white) students had an experience(s). While 8 in 10 of the non-URM students have had such an experience, only 7 in 10, or 87.5% (⅞) as many non-URM students, are getting gaining experiences. We found no statistically significant differences between URM and non-URM groups, nor between each group divided into those with and without experiences.

When considering gender, there exists no statistical difference between the readiness of males or females who have had no professional experience. However, there does exist a statistically significant difference between the two genders for those who have had some number of professional experiences. This demonstrates that the impact of those experiences on female students is noteworthy.

Conclusion

This study considered survey responses from 282 students in the college of engineering, of which 180 provided complete responses. We looked at student practice readiness by using a validated perceived holistic measures instrument, developed by Chan et al. 2017 and Chan and Luk 2020, which is aligned with National Association of Colleges and Employers (NACE) and current literature. The demographics representation of the respondents closely matched that of the college. Respondents collectively self ranked their confidence for each holistic competency between average to very confident. Within our inclusive definition of a professional experience, we have seen that having any of these experiences makes a difference as compared to not having any such experiences. There is suggestive evidence of a strong, and positive correlation between a student's readiness and the number of professional experiences they have. Further there exists a positive, and significant, correlation between the number of professional experiences and a student's professional identity. Students with any professional experiences have a significantly higher self rated professional identity than those without any such experiences. For our students to identify themselves as engineers, having two experiences proved most constructive.

The URM students in this study report a very similar readiness to non-URM students, in contrast with NACE. This suggests that the many efforts to engage underrepresented minority students at this university have been fruitful and effective. However, there still exists an opportunity for improvement within the college, as underrepresented minority students are 87% as likely as non-minority students to have professional experiences before graduation. Prior to an experience, there is no statistically significant difference between female and male students for practice readiness. Following an experience, there is a statistically significant difference between the genders. This supports the hypothesis that experience matters, specifically for females.

This work shows that, inspiration is almost as impactful as preparation or reinforcement experiences on students' career choices. Therefore, we suggest that career development efforts can help remedy the discrepancy between industry expectations and students' practice readiness by emphasizing all kinds of experiences matter, related to one's major or not. Further, we suggest targeted recruitment of females into eclectic experiences to close the career readiness gap between the genders.

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Appendix 1: The survey used in this study was a combined version of Chan and Luk (2020) with the addition of context questions to address students' experiences. Questions (Q#) are noted with (r) as required, (o) as optional, † as dependent on "yes" to Q4 *a-d*, and ‡ as dependent on "yes" to any of Q4. Multiple choice questions are marked with a ✓. Subquestions are noted with a *lightened italic number or letter*. * Q10 scale applies to all subquestions.

Q1 (r)	School email: *[used for campus self reported gender and ethnicity]*					
Q2 (r)	Please indicate your program of study *[menu of programs specific to institution]*:					
Q3 (r)	How many semesters (after this one) do you anticipate there are before your graduation?					
		0				
		1				
	✓	…				
		10				
		Likely more than 10				
Q4 (o)	Which of the following experiences can you identify having had a significant impact on you (outside of classwork), to the extent that you now feel competent to teach it to someone else?					
	a	Worked for an organization (paid or volunteer) in a position related to my major				
	b	Worked for an organization (paid or volunteer) in a position NOT related to my major				
	c	Did research (paid or volunteer) in a position related to my major				
	d	Did research (paid or volunteer) in a position NOT related to my major				
	e	Personal experiences, like Camp (summer or any other time of year), sports teams/practice/ competitions, art/music lessons/practice/group, religious studies or group, self-taught skills (learning computer language/coding, flying drones, fixing a car, woodworking...)				
	f	Other *[open ended response]*				
Q5 (†)	Please provide the name of the organization(s) you completed your experience(s) with:					
		[open ended response]				
Q6 (†)	Please copy/paste your job description or summarize your duties here:					
		[open ended response]				
Q7 (‡)	Give a brief description of the experiences you have found most influential in your career choice(s). Ex. I rebuilt a car engine during high school / I enjoy flying drones in my spare time / I participated in a summer coding camp/ I've been training and riding horses since I was 6 / my family and I go hunting every year / I have been playing the saxophone since I was 8 / my high school science teacher said I have the skills to follow this career path/ I went on a year-long mission for my church / I have participated in 3 mock United Nation competitions...					
	1	First Experience *[open ended response]*				
	2	Second Experience *[open ended response]*				
	3	Third Experience *[open ended response]*				
	4	Fourth Experience *[open ended response]*				
Q8 (r)	Please indicate your agreement with the following statement: I intend to complete an engineering degree within the next five years.					
	✓	*Strongly Disagree*	*Disagree*	*Neutral*	*Agree*	*Strongly Agree*
Q9 (r)	How confident are you that you are on the right track for your desired future career?					
	✓	*Not at All Confident*	*A Little*	*Average*	*Above Average*	*Very Confident*

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Q10 (r) How would you assess your current level in the following competencies? *

✓	*Very Poor*	*Poor*	*Average*	*Good*	*Very Good*
a	Express and receive ideas clearly				
b	Communicate with others effectively in different contexts				
c	Build and maintain relationships				
d	Persuade others				
e	Motivate others				
f	Lead others				
g	Be responsible for team members				
h	Be reliable				
i	Identify problems				
j	Think critically				
k	Analyze and evaluate an issue				
l	Have the ability to effectively find, evaluate, and use information				
m	Have information technology skills				
n	Have numerical skills				
o	Be aware of ethical responsibility				
p	Respect individual differences and preferences				
q	Have a sense of citizenship and responsibility to contribute to the society				
r	Understand your own culture				
s	Understand and respect other cultures and perspectives				
t	Be aware of personal strengths and weaknesses				
u	Be able to develop clear goals, self-direction, and self-discipline				
v	Self-confidence				
w	Consideration for others				
x	Appreciation for others				