Communication Expectations to Industry Realities

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“All communication is important”:
Comparison of Incoming Freshmen Communication Expectations to Industry Realities

Abstract

While the development of communication skills is critical to a successful career in engineering teaching these skills continues to be one of the biggest challenges for engineering faculty. A recent survey of students completing engineering internships indicated that their most frequent forms of communication were informal conversations and discussions either with other engineers (i.e., both in and out of discipline) or non-engineers (i.e., both with and without technical degrees). Additionally, students indicated that their internship experiences were significantly more effective at preparing them for future communication than their college coursework. This is likely because a majority of communication in the classroom and communication practice is focused on formal lab reports and/or discussions targeted towards expert audiences (i.e., other students and faculty). Currently, those students who do not complete an industrial internship (or co-op) are graduating from their engineering programs with limited perspective and practice of the communication requirements necessary for a career in engineering.

As a first step to understanding the gap in our curriculum, a survey was developed to investigate student perceptions of communication requirements. The survey asked students to indicate the expected frequency and importance of different communication audiences and types in their future career. To date, data have been collected from 178 incoming freshmen to understand their expectations for communication within their career. Freshmen were in their first semester of college, so they had little exposure to engineering experience or coursework. In parallel, data was collected from 55 post-graduate engineering employees to allow for comparison between students' perceptions and the lived experiences of engineers in their careers. Overall, it was found that there were significant differences between student perceptions and the actual communication requirements of a career in industry. Student perceptions of importance of communication were better aligned with post-graduate data than expectations for frequency of communication. For non-technical audiences, frequency and importance of communication were underestimated, representing an important opportunity for faculty intervention through integration of non-technical communication skills into the curriculum. By integrating non-technical communication into the curriculum and discussing the prevalence of non-technical communication in industry, this will help to align student expectations with realities. To address the limitations of this study, data from engineering students at different stages of their college careers is being collected. Additionally, data collection is ongoing for post-graduate employees, which will allow for analysis of data by specific subgroups (undergraduate major, career experience, career sector, etc.). These data will again be compared to student perceptions to allow for identification of key opportunities for curriculum changes to help align student expectations with the lived experiences of practicing engineers.

Introduction

Communication skills are crucial for success as a practicing engineer, with survey data showing that working engineers spend up to 64% of their time at work on communication [1]. Further, communication across the disciplines scholars (i.e., a focus on how communication skills may fit and translate in a variety of majors) have stressed the importance of embedding communication into program curriculum [2]. More specifically, they call programs like engineering to consider how these skills will prepare their students to communicate with various audiences and through different communication channels (i.e., types) [3].

Despite the importance of communication, often times what is taught in the classroom does not align with expectations for students on the job. In a review of the literature in 2011, several key disconnects were identified between communication in an undergraduate engineering program and communication in an engineering career [4]. First, assignments that students are completing differ from communication they will encounter in industry with respect to audience, purpose and occasion. Second, recent graduates do not have a strong understanding of what skills they learned through their undergraduate curriculum apply in a professional setting. Finally, the definition of strong communication skills through an undergraduate curriculum may not be the same as the definition of strong communication skills throughout a career [4].

These findings are supported by a recent study of engineering intern students where students were asked to evaluate how well their course curriculum and their internship program prepared them for communication with different audiences and through different styles of communication [5]. Students indicated that their internships were significantly more effective at preparing them for nearly all forms of communication compared to their classroom curriculum. In particular, internships were most effective for communication to a non-technical audience, to management and through informal means (in-person discussions, phone calls, etc.). Interestingly, in a survey of recent mechanical engineering graduates, a majority of graduates (52%) considered their written and oral communication skills to be strong [6]. In a parallel survey, only 9% of industry representatives considered the communication skills of recent mechanical engineering graduates to be strong. These results suggest that student and recent graduate perceptions of communication on the job are not aligned with actual expectations.

There are several strategies that programs have developed in an attempt to remedy this disconnect [7]. In many programs, there has been a push towards integration of communication across the curriculum, where communication skills are emphasized in a broader range of engineering courses. Additionally, some engineering programs have developed partnerships with English, communication or technical communication departments to develop communications courses that are tailored specifically to engineering skillsets. While these strategies can help to

remedy communication gaps, it is crucial to first understand exactly what content needs to be emphasized within the curriculum.

Therefore, comparisons of student perceptions of communication in an engineering career to the lived experiences of engineers could provide perspective for identifying key misconceptions that could be corrected through curriculum intervention. In this study, a survey of freshmen engineers (just out of high school) was conducted to determine their expectations for communication in their future careers. Students were asked to rate the frequency and importance of communication to different audiences and through different means of communication. Student perceptions were then compared to data from practicing engineers, allowing for identification of key disconnects between student expectations and practical application of communication skills.

Method of Data Collection

For the first part of this study, participants were first-year engineering students from the University of Kentucky. Survey data were collected in the Fall of 2019, so students were in their first semester of study in college. Through collaboration with the college undergraduate advisors and the first-year engineering program, the survey was delivered to all first-year students across all engineering majors within the college. Only those students who gave consent for participation in the study completed the survey. The email administered to students contained an IRB-approved cover letter and a link to the survey, which explained the purpose of the study as well as how data would be used for research purposes. Additionally, those students identifying as under 18 or those who do not consent to the survey did not have the ability to answer any of the survey questions. Participation in the survey was voluntary and did not have an impact on student grades or credit. Lastly, the Qualtrics survey was designed to take approximately 8 to 10 minutes and no identifying information were collected or stored to ensure anonymity.

Participants were asked to think about their future career and then identify how frequently they thought they would need to communicate with a particular audience and how important communication with that particular audience would be for their career. Audiences types were described as: engineers (same discipline), engineers (different discipline), non-engineers (no technical degree), managers (engineer), managers (non-engineer), external employees (contractor, supplier, etc.), clients, government agencies, the general public and “others” (i.e., textbox was also offered). Additionally, participants were also asked to think about their future career and then identify how frequently they would use particular types of communication as well as the importance of a particular type of communication for the success of their career. Communication types were described as: in person (informal conversation), formal meeting (PowerPoint presentation), formal meeting (discussion), written report, email, phone conversation, and online meeting. For both questions inquiring about frequency, participants selected from: very frequently (more than 2 times per day), frequently (1-2 times per day),

occasionally (2-3 times per week), sometimes (once a week), rarely (2-3 times per month), very rarely (once a month or less), or never. For both questions inquiring about importance, participants selected from: very important, important, moderately important, slightly important, or not important.

For the second part of this study, participants were engineers currently employed in the field (i.e., post-graduate employees) with at least a bachelor's degree in engineering. Survey data were collected in the Winter of 2020. Through collaboration with stakeholders in engineering, network sampling was employed. Only those who gave consent for participation in the study completed the survey. The email administered to participants contained an IRB-approved cover letter and a link to the survey, which explained the purpose of the study as well as how data would be used for research purposes. Additionally, those identifying as under 18 or those who do not consent to the survey did not have the ability to answer any of the survey questions. Participation in the survey was voluntary and did not have an impact on the participant. Lastly, the Qualtrics survey was designed to take approximately 8 to 10 minutes and no identifying information were collected or stored to ensure anonymity.

Similar to the first part of the study, were asked participants to think about their current career and then identify how frequently they communicate with a particular audience and how important communication with that particular audience was on their career. Audiences types were described as: engineers (same discipline), engineers (different discipline), non-engineers (no technical degree), managers (engineer), managers (non-engineer), external employees (contractor, supplier, etc.), clients, government agencies, the general public and "others" (i.e., textbox was also offered). Additionally, participants were also asked to think about their career and then identify how frequently they use particular types of communication as well as the importance of a particular type of communication on the success of their future career. Communication types were described as: in person (informal conversation), formal meeting (PowerPoint presentation), formal meeting (discussion), written report, email, phone conversation, and online meeting. For both questions inquiring about frequency, participants selected from: Very frequently (more than 2 times per day), frequently (1-2 times per day), occasionally (2-3 times per week), sometimes (once a week), rarely (2-3 times per month), very rarely (once a month or less), or never.

Analysis of Data

To investigate differences between freshmen student perceptions and post-graduate employee experiences, Likert-type scale distributions were analyzed using the Mann-Whitney U test with a significance level of 0.05. For this analysis, a p-value less than 0.05 indicates a significant difference between the distributions.

Results and Discussion

Response Rates

Freshmen survey responses were received from a total of 178 students (23% response rate) representing all 10 engineering degrees in the college of engineering at the University of Kentucky (Table 1).

Table 1. Distribution of freshmen respondents across majors and career interests

Major	Biomed	3%
	Biosystems	4%
	Chemical	16%
	Civil	8%
	Comp. Eng.	7%
	Comp. Sci.	26%
	Electrical	4%
	Materials	5%
	Mechanical	23%
	Mining	1%
	No Major	3%
	Other	1%
Career	Academia	6%
	Industry (management)	38%
	Industry (research)	21%
	Unsure	30%
	Other	6%

The distribution of students is representative of overall student distributions across majors. Nearly 60% of students expressed interest in pursuing a career in industry and 30% of students were still unclear about their desired career pathway.

To date, post-graduate employee responses have been received by 55 respondents representing 11 engineering majors (Table 2).

Table 2. Distribution of post-graduate respondents across undergraduate majors and career categories

Major	Aerospace	2%
	Biosystems	2%
	Chemical	56%
	Civil	15%
	Electrical	11%
	Environmental	2%
	Industrial	4%
	Materials	4%
	Mechanical	2%
	Mining	2%
	Nuclear	2%
Career	Academia	5%
	Business	24%
	Consulting	18%
	Government	11%
	Law	2%
	Management	18%
	Medicine	5%
	Manufacturing	45%
	Research	27%
	Other	11%

A majority of respondents had bachelor's degrees in chemical engineering (56%). As data collection is still ongoing, it is expected for this sampling bias to decrease. Unlike the freshmen survey, the post-graduate survey asked respondents to characterize their career based on frequent engineering career categories. Respondents could choose more than one option when characterizing their position. The three most common choices for career characterization were manufacturing (45%), business (24%) and research (27%). Only 5% of respondents considered their career to be in academia, which is consistent with future career interests of freshmen respondents.

Audience of Communication Misconceptions

To better understand student misconceptions, data from freshmen were compared to data collected from post-graduate employees. With regard to frequency of communication, Likert-type scale distributions for freshmen expectations and post-graduate employee data were statistically the same for technical employees (different disciplines), technical managers and external employees (contractors, suppliers, etc.). Significant differences in distributions were determined for technical employees (same project area) ($p = 0.049$), non-technical employees ($p \approx 0$), business managers ($p \approx 0$), clients ($p \approx 0$), government ($p \approx 0$) and the general public ($p \approx 0$). The Likert-type scale distributions for both populations for these categories can be seen in Figure 1.

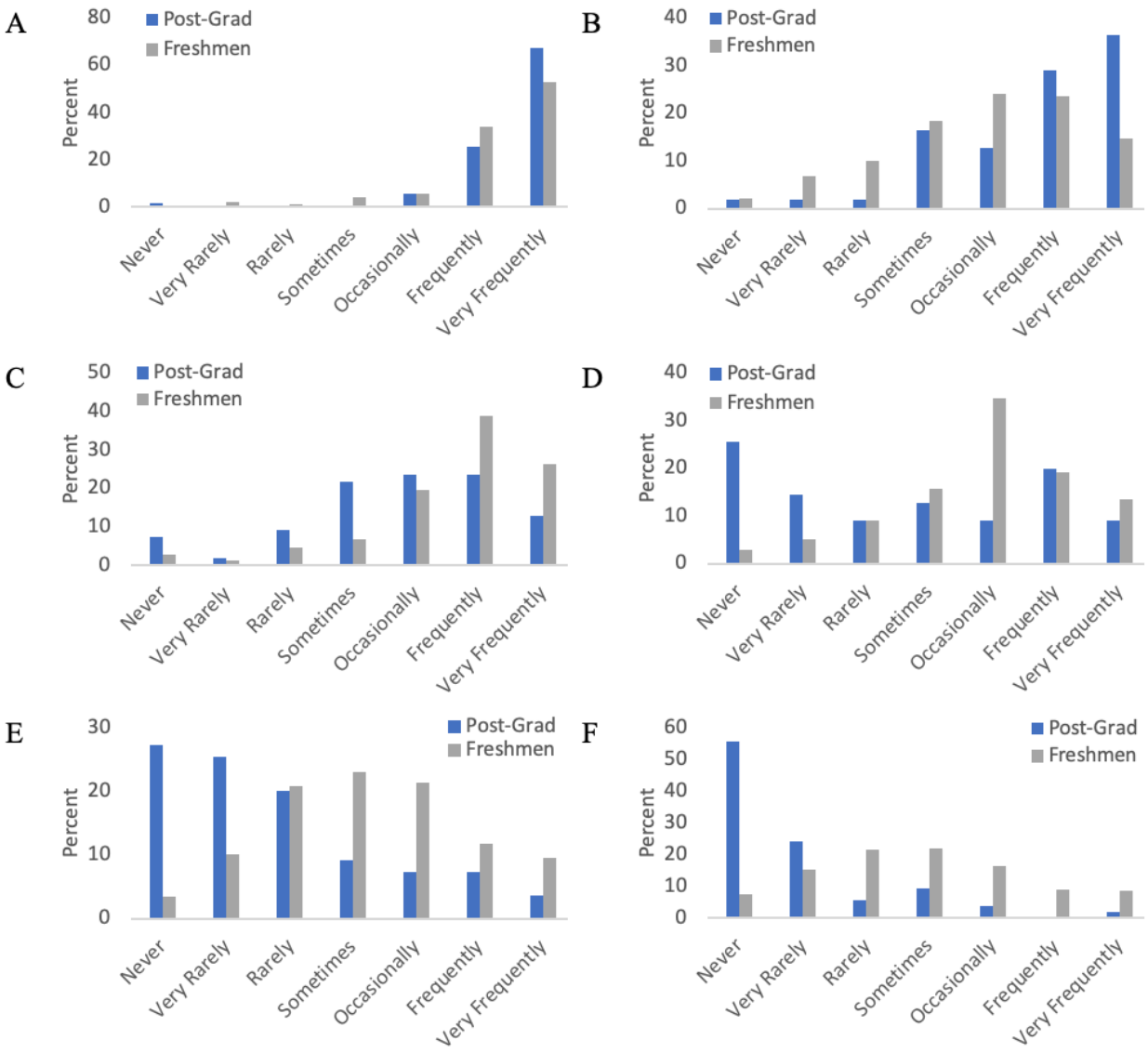

Figure 1. Comparison of the Likert-type scale data distributions for freshmen and post-graduate employees describing frequency of interactions with different audiences (A: technical employees (same project area), B: non-technical employees, C: manager (business), D: client, E: government, F: general public).

For technical employees, only 53% of freshmen expected that they would have interactions with engineers within their project area multiple times per day as opposed to 67% of post-graduate employees. Similar results were seen for the non-technical audience, with just 15% of students expecting a very frequent interaction as opposed to 36% for post-graduate employees. Conversely, freshmen overestimated the frequency of interactions with business managers, clients, government and the general public.

When asked to determine the importance of communication with different audiences, the only significant differences between freshmen and post-graduate employees were for non-technical employees ($p = 0.049$) and the general public ($p \approx 0$) (Figure 2).

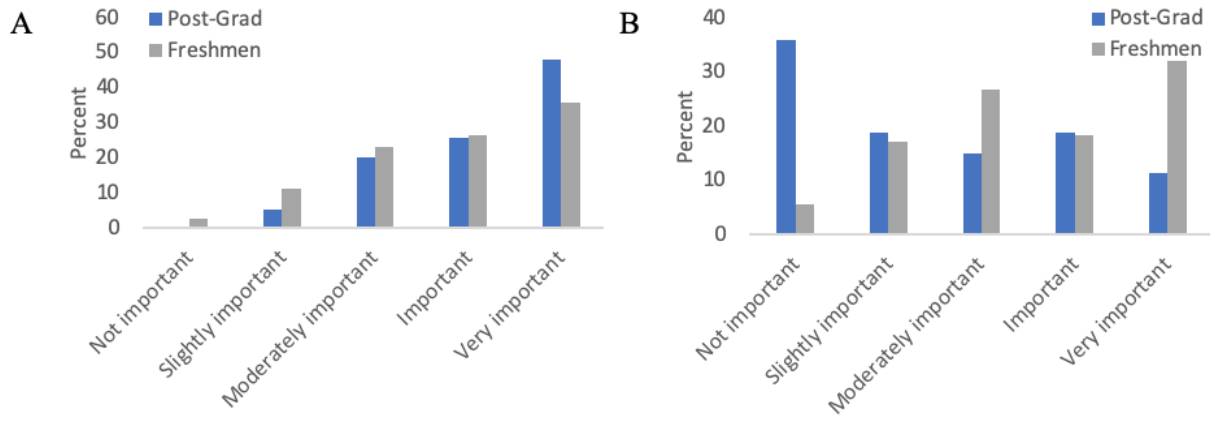

Figure 2. Comparison of Likert-type scale data distributions for freshmen and post-graduate employees describing importance of interactions with different audiences (A: non-technical employees, B: general public).

For the non-technical audience, only 36% of freshmen perceived communication with a non-technical audience as very important as compared to 48% of post-graduate employees. There was a significant difference in alignment for the importance of communication to the general public. For the post-graduate employees, this was the only communication audience that did not shift towards high levels of importance. Freshmen student perceptions of the importance of communication with the general public were significantly higher than those of post-graduate employees, with 77% of students perceiving interactions as moderately important or higher as compared to 45% of post-graduate employees.

Types of Communication Misconceptions

When looking at misconceptions about the frequency of different types of communication, the only two types of communication that showed agreement between freshmen and post-graduate employees were phone conversations and skype/online meetings. Significant differences were found for informal in-person communication ($p = 0.005$), email ($p \approx 0$), meetings ($p \approx 0$), presentations ($p \approx 0$), written reports/grants ($p \approx 0$) and teaching or training ($p \approx 0$) (Figure 3).

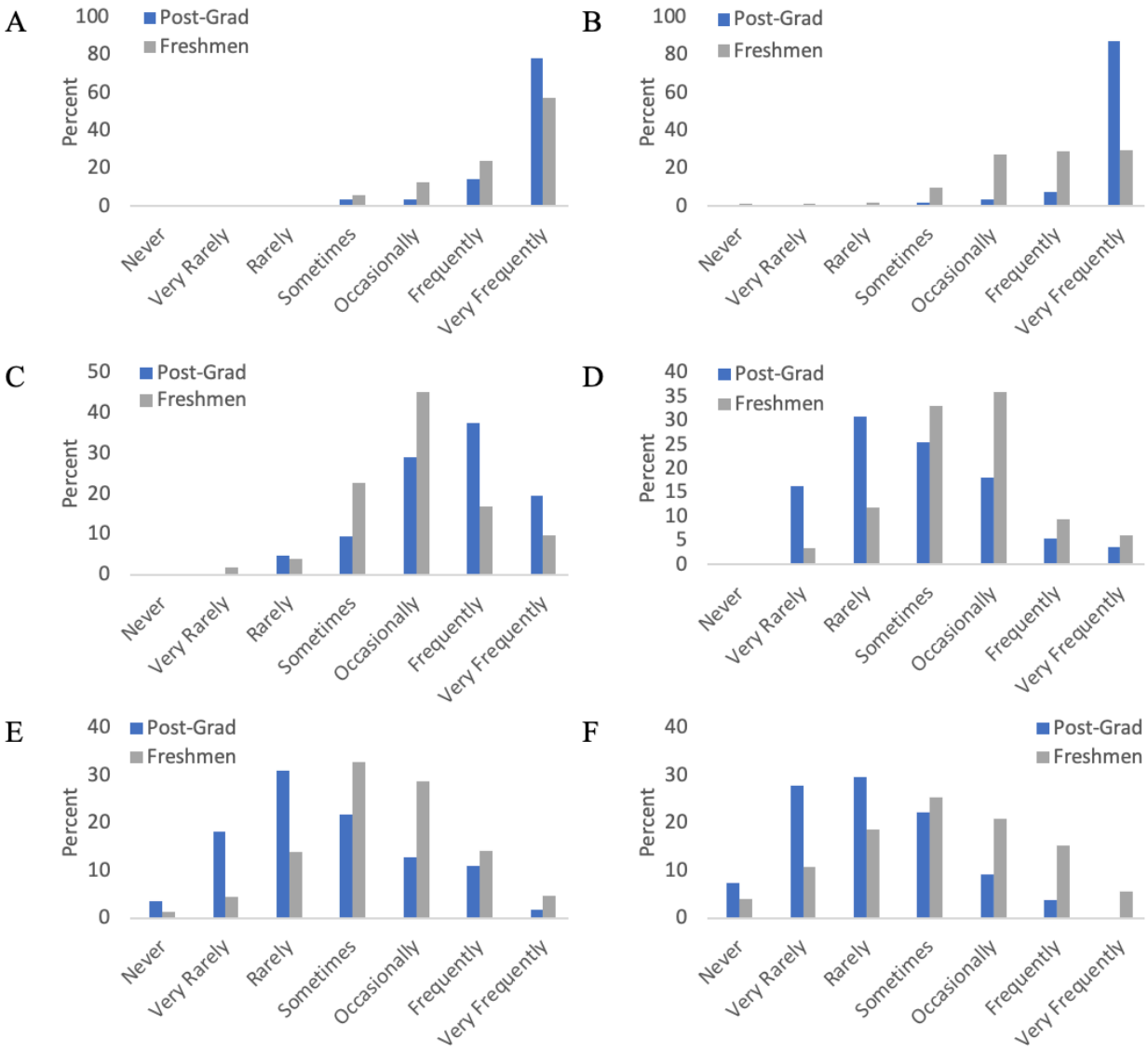

Figure 3. Comparison of Likert-type scale data distributions for freshmen and post-graduate employees describing frequency of different types of communication (A: informal in-person, B: email, C: meeting participation, D: presentations, E: written reports/grants, F: teaching or training).

Interestingly, freshmen expected lower frequencies of communication for more informal forms of communication (informal in-person communication, email and meeting participation), whereas they expected higher frequencies for more formal communication (presentations, written reports/grants and teaching or training).

In looking at the importance of different forms of communication, freshmen perceptions agreed with data from post-graduate employees for all types of communication except for email ($p = 0.04$) (Figure 4).

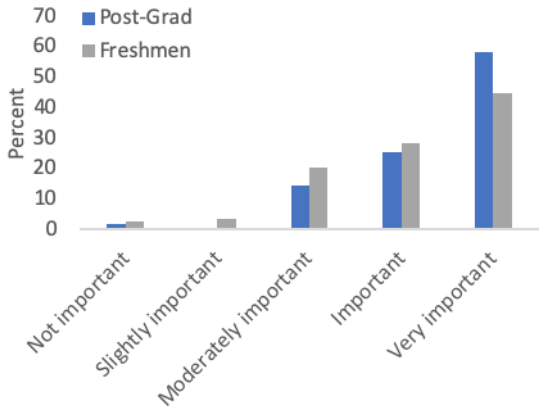

Figure 4. Figure 1. Comparison of Likert-type scale data distributions for freshmen and post-graduate employees describing the importance email communication

The main discrepancy in these distributions was the number of respondents perceiving email as very important (58% of post-graduates and 45% of freshmen students).

Discussion

Overall, there were significant disconnects between freshmen perceptions of communication and the lived experiences of post-graduate employees. In general, there were higher levels of disagreement for frequency of communication than there were for the importance of communication. For non-technical audiences, freshmen underestimated both the frequency and the importance of interactions. This is likely due to the lack of practical experience of the students.

Freshmen students tended to underestimate the frequency of more informal types of communication (meeting participation, in person and email) and overestimate the frequency of more formal types of communication (presentations, written reports and teaching/training). This could be due to the focus of high school and college level curriculum on developing these more formal communication styles.

Areas with more significant misconceptions present an opportunity to modify student perceptions through integration of varying communication audiences and styles across the curriculum. This could be accomplished not only through formal communication assignments, but also through informal discussions. For instance, active learning activities could ask students to talk to their neighbor about how they would explain a concept to a non-technical plant operator rather than having them explain the concept to another engineer. Through this framing of the question, the goal of having students clarify concepts is still accomplished, but they are also thinking about the importance of communication to diverse audiences.

One potential cause of disagreement between freshmen and post-graduate data could be the distribution of majors associated with each population. While freshmen majors were more evenly distributed across all engineering majors, 56% of the post-graduate responses had chemical engineering bachelor's degrees. Through collection of a broader span of data from post-graduate employees, data analysis by subgroup could provide insight into how communication requirements change across major, career experience, career sector, etc.

An additional limitation of the current data set is that all students were taking the survey at the beginning of their first semester in college, representing students who had little experience in engineering-based coursework. To learn more about how perceptions change as students transition through the curriculum and participate in extracurricular activities (internships, co-ops, research experiences, etc.), data will be collected from second semester freshmen, sophomore, junior and senior students. Through integration of the survey with advising meetings, high-response rates should allow for analysis of data across differing subgroups within engineering (major, academic year, etc.). Additionally, asking students if they have close family or friends who work as engineers could provide interesting insight into how students are developing the perceptions that they have for industry communication.

Conclusion and Future Work

Taken together, there are opportunities to address the aforementioned limitations with future work. For example, longitudinal data collection at multiple points in an academic year spanned over students' academic careers could provide insightful understandings regarding how student expectations may evolve as they learn more content and engage in internships or co-op experiences. Overall the findings indicate discrepancies between what students expect for their communication experience and what actual communication experience they encounter. In order to better prepare engineering students for success in their future careers, addressing these discrepancies early in their academic careers may allow for more time for them to learn and practice those necessary communication skills.

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