"Speak Up!" A Program for Teaching Communication Skills to Summer Undergraduate Researchers

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Kevin joined Carnegie Mellon University in July 2013 as the Associate Dean of Student Affairs for Career and Professional Development. In this role, Kevin leads the career center's efforts in providing leading career development and recruiting services.

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Kevin has specialized in identifying untapped areas within student populations and offering service that provide high student engagement. In addition to "high touch" engagements, Kevin has been celebrated for delivering career management services to distance audiences. He was awarded the CASE Circle of Excellence Gold Award for online alumni services and was a Bronze Award recipient for distance educational programming. Kevin is a graduate of Notre Dame and earned his masters from the University of Portland.

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1.   Introduction

Communicative competence has long been acknowledged as a critical engineering skill, and is among the core student learning outcomes for both the ABET and Engineers Canada accreditation boards. We know from workplace surveys and ethnographic studies that engineers spend a tremendous amount of time writing and speaking [1], and that the amount of time spent communicating increases exponentially as engineers move into middle- and upper-management positions. And yet, surveys of hiring managers consistently suggest that the communication skills of new hires are lacking, that these skills are critical considerations in both hiring and promotion, and that remediating these skills is expensive. As a report by the National Commission on Writing indicated more than a decade ago, these issues are by no means unique to engineering [2]; however, given the central role of the engineer in engaging in work with real consequences for public health and safety, the importance of communication skills in engineering fields is greatly magnified--and greatly scrutinized during times of crisis and disaster.

For the modern engineering student, the list of requisite professional communication skills therefore goes well beyond proficiency in creating technical genres for fellow technical experts, and additionally demands an ability to communicate one's technical expertise to field-adjacent and non-expert publics. This need for expert-to-public communication is very strongly articulated by the Engineers Canada accreditation criteria for graduate attributes, which emphasizes students' "ability to communicate complex engineering concepts within the profession and with society at large" [3, p. 14, criterion 3.1.7]. This more nuanced articulation of the communication skills required of the 21st-century engineer was also forecasted by the National Academy of Engineering "Engineer of 2020" reports, in which they acknowledge the increasing ways in which engineers "pursue collaborations with multidisciplinary teams of technical experts," that "important attributes for these teams include excellence in communication" [4, p. 10], and that it is "both the responsibility of engineers and important to the image of the profession that engineers increase their ability to eloquently articulate the relevance of engineering to many public policy issues" [4, p. 11].

Facility in this kind of cross-audience engagement requires student learners to see communication as a rhetorical activity shaped by audiences, purposes, and contexts, and to learn requisite strategies for rhetorical engagement [5]. However, students' schedules do not often allow for the kinds of stand-alone technical communications courses in which these concepts are introduced, nor do they necessarily take such courses alongside field-adjacent or out-of-field peers. Additionally, research from the learning sciences [6] has shown that students' comprehension and motivation are strengthened when they engage in scaffolded learning activities for which they can get immediate practice and feedback, and can see immediate transfer potential to their other academic and professional activities.

At Carnegie Mellon University, one such activity in which many students are engaged in a combination of technical and professional communication skills is undergraduate research. Each year, students receive support from our undergraduate research office and other sponsored

sources to conduct research, either as individuals or in collaboration with faculty sponsors. Our largest campus unit, the College of Engineering, represents a substantive percentage of those students who have an undergraduate research experience. Research is, of course, an activity in which strong written and oral communication skills are expected [7], and at our institution, these expectations are stretched further for students as they culminate their research experience with a public presentation at an end-of-year symposium called Meeting of the Minds.

In summer 2016, a multidisciplinary team of faculty and administrators in engineering, technical communication, learning sciences, and professional development partnered with campus administrators from the undergraduate research office to create a technical communications program for one hundred students engaged in summer research on campus. The "Speak Up!" program, administered weekly across five, 90-minute lunchtime sessions, was designed to teach core communication skills through a series of non-evaluative (not-for-grade or credit), real-world activities and genres focused on helping students develop a more polished and professional voice for public communication of research.

2.   Research Question

In fall 2015, the undergraduate research office at Carnegie Mellon University began investigating ways in which communication skills could be improved among students engaged in campus research, using the research experience itself (as opposed to a required course for credit) as a way to introduce and reinforce critical communications concepts. Motivations for pursuing a communications program for these students stemmed from a combination of: 1) results from a post-survey (the Summer Undergraduate Research Experience, or SURE III) of summer undergraduate researchers that suggested students perceived little gain in facility with core oral and written communication skill during their research experience, 2) energy and conversations at the university level about how to offer students a more flexible, modularized curriculum that reinforced targeted skills through micro-courses, minis, or other shorter-term learning experiences; and 3) acknowledgement of the learning sciences literature on the benefits of pairing learning alongside real-world practice.

2.1 The need for more communications training in summer undergraduate research experiences

The SURE III, a nationally normed set of instruments developed and administered by David Lopatto at Grinnell College, includes a pre-program survey which is completed at the beginning of the summer experience, a post-program survey which is completed at the immediate conclusion of the summer experience, and a follow-up survey which is completed at the conclusion of the subsequent academic year. Funded by the Howard Hughes Medical Institute (HHMI), the SURE survey was first administered in 2004 [8]. With 44 total items, it includes 21 items in which students rate individual learning gains on a 5-point Likert scale ranging from very large gain (5) to no gain or very small gain (1). The items cover a comprehensive range of potential gains including development of project-specific skills and theoretical understanding, engagement with the research process, and development of technical communication skills.

Historically, published aggregate results of the SURE III provide a window into the need for supplemental programming to foster the development of student communication skills in the

context of undergraduate research experiences. In both the first [8] and second [9] nationwide administration of the SURE survey, skill in oral presentation and skill in science writing were among the lowest rated gains followed only by learning ethical conduct. In the 2015 institutional administration of the SURE survey for students participating in undergraduate research experiences in the STEM fields at Carnegie Mellon University, self-reported learning gains in science writing and oral presentation skills were lower than national averages for all research universities participating in the SURE III survey and all participating institutions [10] as summarized in Table 1 below. The "Speak Up!" program was therefore motivated by a central question that will nonetheless be applicable to others: Given **many students**, **great need**, **little time**, and **limited resources**, how might we help undergraduate researchers learn and practice **critical communication skills**?

	Mean score for respondents from Carnegie Mellon University (*n = 41)*	Mean score for all respondents from participating SURE-III research universities (*n* = 1114)	Mean score for all respondents from all participating SURE-III institutions (*n* = 3029)
Skill in science writing	3.15	3.30	3.21
Skill in how to give effective oral presentations	3.18	3.54	3.47

Table 1: Select results from 2015 SURE-III post-program aggregate response report to Carnegie Mellon University. The response rate for summer 2015 respondents from Carnegie Mellon University was 70.7%. Responses reflect self-reported learning gains for each construct and were measured on a 5-point Likert scale ranging from very large gain (5) to no gain or very small gain (1).

2.2 Efforts to build a communications program for summer undergraduate researchers through broad stakeholder collaboration

In 2010, the American Society for Engineering Education issued two reports on the future of scholarly and systematic innovation in the discipline. Among their recommendations for success, ASEE urged those engaged in new pedagogies to be sure to gain broad, collaborative participation among stakeholders invested in students' learning:

> Growing the body of knowledge on engineering learning and incorporating it into engineering educational practices will require a *conscious effort* from all stakeholders--faculty and administrators, scholars and practitioners--*to reach out and work with one another*; a difficult task, but one that will lead to significantly improved learning environments [11].

At Carnegie Mellon, where undergraduate students are admitted into particular colleges (e.g., the College of Engineering, the School of Design, etc.), and where each college unit has its own separate general education requirements, collaboration in cross-campus education endeavors must indeed be a conscious effort to avoid the "siloing" effect. Because our desire was to explicitly create a non-siloed experience in which students engaged in undergraduate research got the pedagogical benefit of communicating their expertise *across* disciplines, input from a broad range of faculty, educators, and administrative stakeholders was crucial. Regular meetings

throughout the 2015-16 academic year were essential to refining the program's scope and learning outcomes, and included administrative directors from the undergraduate research office, specialists from our campus writing center, technical communications educators, professional development leads from our career center, as well as deans and faculty advisors from our engineering unit. For assessments, we additionally collaborated with the director of Carnegie Mellon's Eberly Center for Teaching Excellence and Educational Innovation.

3. Methods

Because many students are funded with the expectation that the research experience constitutes full- or near full-time work, the program was both designed and scheduled to dovetail within these students' scheduling needs. Initially, we had discussed what might be accomplished by having a single weekend experience (of the sort that other units on our campus are able to accomplish through intensive weekend experiences and "micro" courses); however, we quickly determined that the kinds of learning outcomes and associated practice activities we wanted for students would need to unfold in a more systematically scaffolded way that allowed for both practice and reflection. The result was a program that stretched across five, once-per-week lunchtime sessions.

The following learning outcomes were established as a baseline for the program:

- Start thinking about yourself as someone who both "does research" and "communicates research" (goal: change the mindset and alter misconceptions about the role that communication plays in research).
- Consider how different audiences and contexts shape the way you speak or write about your research (goal: introduce basic concepts for rhetorical analysis to help students be more nimble communicators across audiences and contexts).
- Practice communicating your research, both orally and in writing, in ways that respond to different communication scenarios (goal: draw on rhetorical analysis concepts to practice adjusting communications for different audiences and contexts).
- Learn to communicate your professional strengths and research interests in ways that are clear, concise, and engaging to diverse audiences (goal: understand and draw on known best practices for communicating complex information).
- Engage in peer feedback and self-reflection exercises to deepen your thinking about how to communicate your research (goal: wherever possible, have students demonstrate learning through peer sharing activities).

Learning outcomes were embedded across five workshops (see Table 2). Each workshop was held in a large ballroom space on campus, with roundtop tables to seat 8-10 students per table. The program culminated in a 3-minute research presentation (3MRP) modeled after the international 3-Minute Thesis (3MT) competition for doctoral students. The opening session focused on strategies to concisely "soundbite" complex research for different contexts and audiences. This was followed by a module about translating professional autobiographies into brief written self-portraits that blend professional and personal skills. The third session introduced participants to the 3MRP competition grounded in a discussion of rhetorical moves to convey the novelty of research to non-expert audiences. The final session and 3MRP collectively

gave students the opportunity to synthesize what they had learned in written form via resumes that communicate professional stories to busy readers and in oral and visual form via the 3MRP presentations.

Week 1. Workshop 1. "First Impressions: Communicating Your Research Soundbite." Students were introduced to basic principles of analysis of audience, context, and purpose through the situated example of six scenarios in which they might be asked to "tell a little bit about their research" (i.e., give a "research soundbite"). Scenarios were designed to prompt conversation about how delivery would be affected by differences in the students' personal familiarity with the audience (friend vs. stranger), the audience's status as an expert or novice in the field, the stakes (high or low) of the communication event, and the level of formality of the interaction. Prior to the workshop, program participants selected a scenario of their choice ranging from a campus barbeque to a job fair to a conference mixer. Students wrote a brief response to the prompt, practiced their response aloud, and then revised. At the workshop, a breakout activity included time for them to practice their responses orally to peers for feedback. The workshop was co-delivered by a technical communications educator from English and the director of our campus career center.

Week 2. Workshop 2. "Snapshot: Public Self Portraits." Students were introduced to principles and strategies for narrating their research interests and professional skillsets in ways that would be pertinent for cover letters, personal statements for graduate school, or in interviews. Prior to the workshop, students were prompted to write a mini professional "snapshot" that summarized their personal and professional skills. In the workshop, students practiced delivering their snapshots orally to peers for feedback on novelty and clarity. The workshop was led by a faculty member in our college of humanities and social sciences who teaches a course on strategies for communicating a public, professional ethos.

Week 3. Workshop 3. "The Delivery: Novel Research Talks." This workshop aimed to prepare students for their final "Speak Up!" activity: a public, three-minute research presentation (3MRP)--3 minutes, 3 slides max, 3 winners--modeled after the international model for the three-minute thesis (3MT) for PhD student researchers. Students were taught a set of "novelty moves" [12] derived from John Swales' C.A.R.S. (Creating a Research Space) model for writing strong introductions, and shown how these novelty moves are threaded through strong examples of previous 3MT winners [13]. The workshop was led by the assistant director of our writing center.

Week 4. Workshop 4. "Storytelling: Resumes and Inform and Engage." This workshop aimed to help students see the writing and design elements of their resumes as rhetorical choices that communicate a professional story. Strategies for writing and document design were included. Students brought a copy of their resumes to share with peers for review at their tables. This workshop was co-led by instructors from Workshop 1, with support from 10-15 career center specialists stationed at each of the student roundtables.

Week 5. Workshop 5. "3MRP: Three-Minute Research Presentation." For the final session, 89 students presented their research in 3-minute, formal presentations designed to communicate their research project concisely. Preliminary sessions were run in parallel to one another

(conference style), with judges and faculty advisors invited to the sessions. The top winner from each of the sessions was then invited to give their presentations a second time during a lunchtime session for all students, after which judges convened to decide on the top three winners.

Workshop	Communications Skills			Workshop Objectives	Workshop Activities
	written	oral	visual		
Communicating Your Research Soundbite	x	x		Learn and practice strategies for engaging diverse audiences with concise, "soundbite" summaries of your research, with the goal of starting a conversation.	Students wrote, revised, and orally practiced responses to scenarios that included the prompt: "Tell me a little bit about your research" (correlate genre: the "elevator pitch").
Public Self Portraits	x	x		Learn to narrate your professional experiences (including research) into pithy personal "snapshots" meant to spark further conversation.	Students write, revised, and orally practiced narrating their public and professional strengths (correlate genre: cover letters / personal statements / professional interviews).
Novel Research Talks	x	x	x	Learn and practice a set of novelty moves and accommodation strategies that expert presenters use to communicate complex research to diverse audiences.	Students watched videos from the 3MT (three-minute thesis) competition for PhDs; analyzed talks for effective use of novelty moves, accommodation strategies for non-experts, and slide design (correlate genre: public research talks).
Resumes as Storytelling	x		x	Learn and practice a set of writing, organizational, and document design strategies to help busy readers quickly absorb a coherent narrative of your professional and research strengths.	Students brought in their resumes to share; campus career center representatives facilitated a peer review and workshop activity at each roundtable.
3-Minute Research Presentation	x	x	x	Combine visual, oral, and writing strategies learned from previous sessions to deliver a concise, compelling narrative of your research and its novelty for non-experts.	Students presented their research to peers, judges, and faculty members in no more than three minutes (3 minutes, 3 slides, 3 winners).

Table 2: "Speak Up!" module summary

4.   Participants

A total of 100 students were invited to the participate in the pilot program (see Table 3), including those who received centralized summer undergraduate research fellowship (SURF) funding, participated in a pilot summer undergraduate research experience program for engineering students (SURE), and received senior honors fellowship funding for research in the humanities and social sciences (H&SS Honors). Students across fields were represented, with the highest level of participation (45%) from the College of Engineering.

Colleges	Research Grant Type				Student Status in Summer 2016			Total (out of 100)
	SURF	SURE	H&SS Honors	Other	Sophomore	Junior	Senior	
College of Engineering	34	8	0	3	17	12	16	45
College of Science	28	0	0	0	5	11	12	28
Humanities & Social Sci (H&SS)	6	0	11	1	3	3	12	18
Interdisciplinary	4	0	0	0	0	3	1	4
Computer Science	3	0	0	0	1	0	2	3
College of Fine Arts	2	0	0	0	0	1	1	2

Table 2: Summer 2016 "Speak Up!" participant demographics ($N = 100$)

Student participation was high across all disciplines with 75% or more of all eligible students attending each session. As shown in Figure 1, attendance percentages for eligible engineering students largely mirrored attendance in the overall population. 84.4% of the eligible engineering students participated in at least four of the five sessions. The same percentage competed in the 3MRP. All three winners of the 3MRP were engineering students.
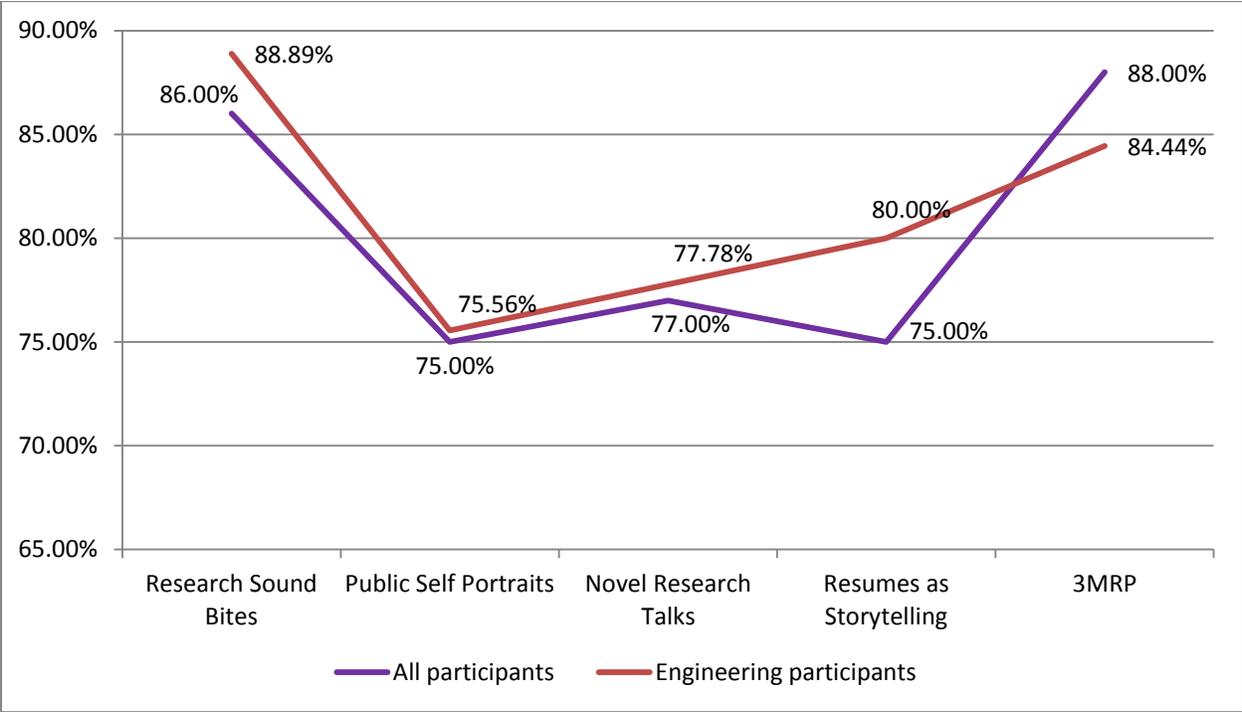
Figure 1: Student attendance for overall study population ($N = 100$) and engineering students ($N = 45$) at weekly "Speak Up!" Sessions.

5. Results

For this pilot program, assessment relative to the communication modules was embedded within a larger study approved by the Institutional Review Board (IRB) that focused specifically on self-reported learning outcomes derived from participation in undergraduate research experiences for students who worked on a project in a science, technology, engineering, and mathematics (STEM) discipline during summer 2016. Two primary sets of measures were utilized: the SURE-III survey administered externally and an instrument developed in partnership with the faculty who were teaching the communication modules to measure participants' beliefs, attitudes, and perceptions regarding their professional and technical communication skills. The specificity of the SURE-III measures necessarily applied solely to students with projects in STEM fields ($N = 81$). This pre-existing limitation coupled with the parameters of the IRB approvals resulted in a limited implementation of the assessment measures and the results pertain solely to students with projects in the STEM fields.

Since the SURE-III pre-program and post-program instruments only have two items focused on communication and focus primarily on learning gains rather than beliefs, attitudes, and perceptions, a "Speak Up!" program-specific survey was developed and administered. It consisted of 15 items focused on the role of communication and its purpose in the respondent's field. Prompts that specifically addressed both written and oral communication were included. Responses were measured on a 5-point Likert scale with options ranging from strongly agree to strongly disagree. Administered at the beginning of the first workshop, the pre-program version of the survey included selected-response (SR) items pertaining to motivation and project tenure as well as a constructed-response (CR) item that asked respondents to itemize three challenges of communicating about their research. The post-program survey was administered immediately following the 3MRP competition. This instrument omitted the pre-program survey items pertaining to motivation and project tenure; retained the 15 Likert-scale items and the CR item; and added three items pertaining to program evaluation.

43.2% of eligible participants, including 19 engineering students, completed both the pre- and post-program surveys ($n = 35$). One-sample chi-square analyses were conducted to evaluate whether the study respondents ($n = 35$) approximate the overall study population ($N = 81$). The results of the test were not statistically significant for university college affiliation, $\chi2(3, n = 35) = 7.297, p = .063$; funding source, $\chi2(1, n = 35) = .714, p = .398$; and class year, $\chi2(2, n = 35) = 1.07, p = .585$. Overall, these results suggest that the university college affiliation, funding source, and class year for study respondents reasonably align with these attributes of the population of undergraduate researchers who were eligible to participate in the "Speak Up!" program. While the results cannot be generalized to the population and the small sample size is a limiting factor, they can offer a reasonable approximation as these demographic characteristics are particularly salient for the population under study.

Results suggest that participation in the professional communication seminar recalibrated students' self-assessment of their oral communication skills. As shown in Figure 2, the percentage of respondents who strongly agreed with each prompt either remained the same or declined from pre-program to post-program assessment. While it may seem negative that the program decreased student confidence in their communication skills in some instance, our

interpretation suggests participation in the program prompted students to reflect on the strength of their oral communication skills and consider how they might need to continue to build their skills in this regard. This interpretation is supported by evaluative comments from the respondents. When respondents who either agreed or strongly agreed were considered, pre-program to post-program gains are visible for all measures. For this particular set of measures, it is possible that a recency effect may have impacted the ratings as participants were instructed to complete the survey immediately following the 3MRP competition. In this competition, they had the opportunity to receive feedback on their presentations from both faculty research mentors in preparation for the 3MRP and from 3MRP judges following the first round of the competition.
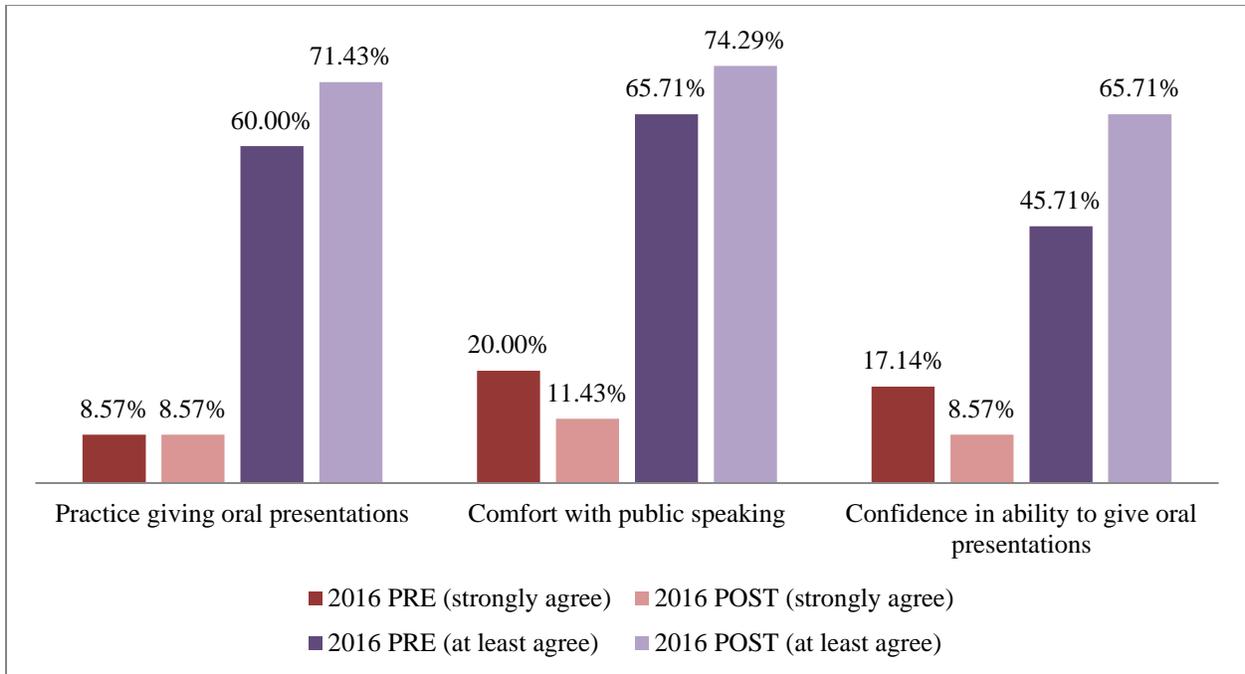
Figure 2: Comparison of select pre-program and post-program responses to oral communication skill prompts. Responses ($n = 35$) reflect self-reported level of agreement with the following prompts: "I have had a lot of practice giving oral presentations;" "I am comfortable with public speaking;" and "I am confident in my ability to give oral presentations."

While specific gains with respect to particular oral communication skills seem to slightly decline, there was a gain in overall assessment of written skills. These measures provide evidence that respondents largely perceived gains in these areas, both in terms of confidence with this skill set and the belief that their resume communicates their strengths. As illustrated by Figure 3, 80.00% of respondents strongly agreed or agreed that they have confidence in their writing skills at the conclusion of the seminar while 71.43% strongly agreed or agreed that their resume communicated their strengths. The strong emphasis on written professional documentation throughout the seminar coupled with the specific exercises with the staff from the career center likely influenced these outcomes measures.
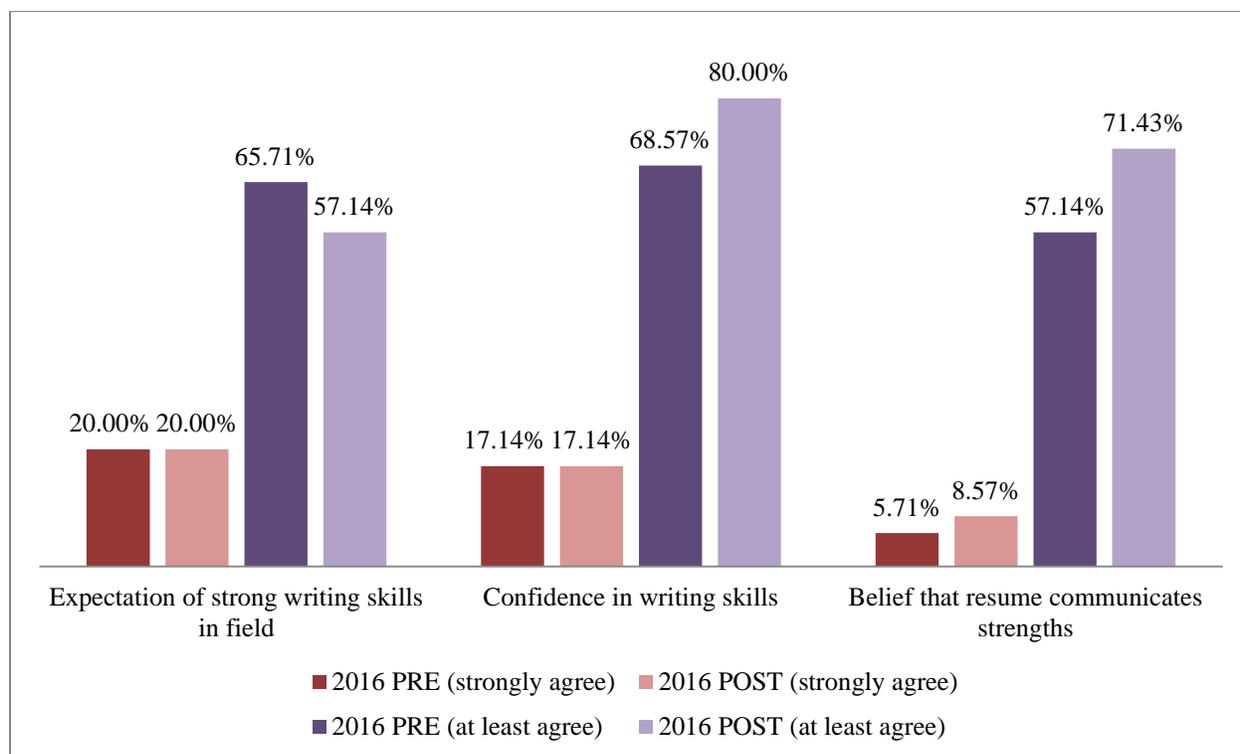
Figure 3: Comparison of select pre-program and post-program responses to written communication skill prompts. Responses ($n = 35$) reflect self-reported level of agreement with the following prompts: "I will be expected to be a strong writer in my first job;" "I consider myself a strong writer;" and "My resume does a good job of communicating my strengths to employers."

With all Likert scale items in the "Speak-Up!" instruments measured on ordinal scales, all additional data analyses were performed using nonparametric procedures. Appropriate for repeated-measures design with variables measured on ordinal scales, the Wilcoxon test was used to evaluate whether any of the respondents' measured beliefs, attitudes, or perceptions changed from the pre-program administration to the post-program administration. No significant differences were found on any of the survey items. Additionally, differences between engineering respondents ($n = 19$) and non-engineering respondents ($n = 16$) were considered. In this case, the presence of the independent samples and the ordinal scales of measurement necessitated the use of the Mann-Whitney U test. This test was conducted on the responses for each of the Likert scale items for the pre-program and post-program administrations to evaluate differences between engineering student respondents and non-engineering student respondents. There were no significant differences between the engineering students and the non-engineering students on any of the Likert scale items on the pre-program or the post-program survey.

Evaluative measures on the post-program assessment indicate that a majority of respondents benefitted from the 3MRP presentation session as shown in Table 4. This was true not only for the total sample of all respondents, but the subset of engineering respondents as well. Results of the self-reported benefits from the other sessions were less conclusive, with less than 50% of all respondents reporting a benefit from the other four sessions. Engineering respondents had slightly higher odds of reporting a benefit for the sessions focused on research soundbites and self portraits than non-engineering respondents. Non-engineering students were more likely to report benefits from the workshop on developing novel research presentations.

	All respondents	Engineering respondents	Non-engineering respondents
First Impressions: Communicating Your Research Soundbite	22.85%	31.58%	12.50%
Snapshot: Public Self Portraits	17.14%	26.32%	6.25%
The Delivery: Novel and Interesting Research Presentations	28.57%	21.05%	37.50%
Storytelling: Resumes and CV's that Engage the Reader	48.57%	47.37%	50.00%
3-Minute Research Presentations	77.14%	73.68%	81.25%

Table 4: Most beneficial seminar topics as reported by "Speak Up!" survey respondents ($n = 35$)

6.   Discussion and Future Directions

As employers increasingly prioritize communication competencies, there is growing emphasis on the development of written and oral communication skills of engineering students. Learning science research suggests that efforts to improve these skills should focus on opportunities for practice, feedback, and transferability. The success of the 2016 "Speak Up!" pilot program has warranted a second round of the program in summer 2017. With the evaluative measures indicating that students found opportunities to practice communication skills such as the 3MRP to be particularly beneficial, these elements will be retained and amplified in the next iteration. We are currently considering how to best incorporate these opportunities for further practice into each session and allow students to receive timely feedback from university faculty and staff at each stage of the process. Other important themes in these ongoing conversations are considerations specific to group size as well as time commitment relative to communications skills versus research obligations.

While the evaluative measures suggest that students perceive a benefit to participation in the "Speak Up!" seminar, the results of the assessment, particularly the Wilcoxon test which indicated that there were no significant differences between the pre-program responses and the post-program responses, suggest that gains relative to beliefs, attitudes, and perceptions that were measured may be limited. With an increasing emphasis on practice and feedback, there is an opportunity, supported by best practices literature in assessment, that suggests a pivot to more direct measures of student learning as the "Speak Up!" program continues to evolve. These direct measures should reflect a balance of constructed-response (CR) and selected-response (SR) items, as SR measures provide psychometric quality and promote ease of analysis while CR items provide accurate measures of actual writing ability [14]. The use of SR measures can be facilitated by classroom response technology, which will foster better connections between measures and attendance and ultimately, enhance reliability and accuracy of the assessments.

Results of the Mann Whitney U test suggest that engineering and non-engineering students shared similar beliefs, attitudes, and perceptions regarding the role of communication in their respective fields. However, observations of patterns of student engagement in each session suggest that students in the "Speak Up!" pilot program may not have utilized this common ground to achieve interdisciplinary engagement. Student attendees tended to enter the sessions

with members of their research groups and sit with the same group. This resulted in interactive session activities often being completed with peers in their own discipline. In future iterations of the program, we plan to experiment with randomization of seat assignments which would further our goal of encouraging students to practice communicating with people outside their area of expertise.

Despite the lack of statistical significance, the results of the assessment do offer evidence of some gains relative to written communication while others suggest that student developed a more accurate self-assessment of oral communication skills. The recalibration that was observed in the response patterns presents an opportunity to consider strategies for measuring if and how students use the "Speak Up!" program as a launching point for continued development in these domains. Rather than placing the burden to seek assistance on students, "Speak Up!" brought the faculty and staff experts to the students. Equipped with a more realistic assessment of their communication skills, there is an opportunity to track and assess whether "Speak Up!" participants are more likely than relevant peers to subsequently visit the career center for continued resume revision, attend workshops offered by the writing center, or enroll in courses pertaining professional and technical communication, thereby affording measures of ongoing development in these domains.

7.   Acknowledgments

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