

## **Integrating Engineering Values Of Community And Professionalism In A First-Year Engineering Sequence**

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### **Abstract**

This study presents the efforts of a new school of engineering to introduce engineering values of professionalism and service as an integrated part of the curriculum through professional development and service event requirements. Engineering students are expected to have skills and values beyond technical competencies upon graduation. This is one way to meet the expectations of employers and professional organizations. Data was collected as part of required coursework, specifically forms that log the hours students spend in professional development and service activities, as well as through end-of-year surveys and conversations with students. Overall, students spend more time per service event than professional development event. More students also tend to attend any single service event. A wider variety of professional development events are reported, with a wider range of students attending (from 1 student to 85 students and from 1 hour to 9 hours). A wider variety of opportunities were reported from the second cohort of students as compared to the first cohort. Students report feeling more like an engineer after taking part in professional development opportunities as compared to service opportunities; students in the second cohort reported higher satisfaction with both activities than students in the first cohort. In a new engineering program, the attempts to integrate professional development and service opportunities were successful at introducing students to the engineering values of professionalism and service. Opportunities were improved based on student feedback and continue to improve in number and variety to meet the needs of the student population.

### **Keywords**

First-year engineering, professional development, extracurricular activities

### **Introduction**

In the US, undergraduate students who complete an engineering degree are expected to have developed more than knowledge of technical content<sup>1,2</sup>. Campbell University's School of Engineering has eight values that are woven throughout the curriculum: ethics, service, professionalism, relevance, community, excellence, ownership, and resilience. These values were developed through the experience and expertise of founding members of the department who drew on a variety of sources including NSPE<sup>3</sup>, ABET<sup>1</sup>, and other experts on engineers and engineering education<sup>2</sup>.

First-year engineering courses are critical in connecting students to the university and building a strong foundation of service and professional development skills. At Campbell University, our first-year engineering sequence strongly integrates two of our values, community and professionalism, into the curriculum. This is done by requiring 25 total hours between both

community service or professional development. Hours are obtained by participating in School of Engineering sponsored events.

## Methods

As part of the first-year engineering courses, every student must complete and document twenty-five total hours, with at least ten professional development hours and at least ten service hours, for 10% of their grade. Students must complete all 25 hours to receive any credit – no partial credit is allowed. To record hours, students turn in a form documenting their participation in the event. The form requires the time spent, the type and location of event, the event supervisor's name and email, date of service, and signature from the event supervisor, and a summary of what the student learned from the event. On the service form, we also require a brief reflection on the service activity. These forms have been collected over the past four semesters. Data has been recorded based on type, length, and frequency of event.

To track the development of students and to refine curricular offerings, at the end of the year students in targeted courses are surveyed. The instrument used is modified from the "Are College Students Adults" instrument as adapted by Meyers et al.<sup>4,5</sup>. Full results have been reported elsewhere<sup>6,7</sup>. This survey includes questions related to the professional development and service hours, specifically:

- Professional Development events made me feel more like an engineer
- Service events made me feel more like an engineer

Responses to the two questions were on a 5-point Likert-like scale from 1 (strongly disagree) to 5 (strongly agree). Results from the professional development and service forms, as well as the results from the end-of-year survey, are quantitatively presented. Supporting evidence from discussions from students is also presented to clarify and focus the quantitative results.

## Results and Discussion

Service hours for the four semesters of data are reported in Table 1. In Fall 2016, there were 18 unique service events that students in both courses reported attending. Common events included assisting with First Lego League teams and the local Lego League competition, representing the School of Engineering during university visitation days when prospective students visited campus, and several instances of students tutoring at various K-12 schools in the area. The mode or most frequent number of students per event is 19, with the most popular event of assisting with First Lego League having a participation of 25 students, while the least attended event was tutoring students at elementary schools. In Spring 2017, 17 unique service events were reported with the FIRST robotics championship held on campus being the most commonly attended. Many students reported completing many service hours in one weekend at this annual event. Other notable events reported in the spring include working at the Science Olympiad competition and helping with the NCWIT affiliate award presentation. In the fall of 2017, 46 unique service events were reported, up considerably from fall 2016. In Spring 2018, 22 unique service events were reported. There were fewer overall students enrolled in the first year courses, which resulted in fewer submitted event reports.

Table 1. Service participation over four semesters

	<b>NO. OF EVENTS</b>	<b>AVG. NO. OF HOURS / EVENT</b>	<b>MAXIMUM NO. OF STUDENTS / EVENT</b>	<b>MINIMUM NO. OF STUDENTS / EVENT</b>	<b>MODE OF STUDENTS / EVENT</b>
<b>FALL '16</b>	18	5	25	2	19
<b>SPRING '17</b>	17	6.5	48	5	7
<b>FALL '17</b>	46	12	85	2	2
<b>SPRING '18</b>	22	5.5	41	4	n/a

Professional development (PD) participation for the four semesters are reported in Table 2. This data includes the number of events students participated in, the average number of hours completed between the two classes, and the maximum, minimum, and mode for each of those events. Reports of unique professional development events grew by over 200% between the first and second year. In fall 2016 there were 30 unique PD events, in the spring there were 28 unique events. In fall 2017, however, 87 professional development events were reported and, in the spring, 65 unique events were reported.

The increase in offerings is attributed to several causes. First, the students requested more PD offerings because in the first year it was difficult to accumulate a sufficient quantity. Second, since the School of Engineering started in Fall 2016, events like fabrication shop training were not yet prepared for administration to students, and fewer student chapters of professional organizations were active in the School. In Fall 2017, however, the shop was well-established and able to offer students additional training in the fabrication shop. Student chapters of the American Society of Mechanical Engineers and the American Institute of Chemical Engineers were also founded. Finally, first-year students also had event ideas passed to them from sophomore students and were more creative in finding events that the School of Engineering allowed for PD. The mode and minimum number of students for all four semesters is the same. This is because many students are active in extracurricular events all over campus, and often get outside approval for unique opportunities to count. Additionally, because we offered so many more events in the second year, fewer students attended certain events, bringing down the minimum and modes.

Table 2. Professional development participation over four semesters

	<b>NO. OF EVENTS</b>	<b>AVG. NO. OF HOURS / EVENT</b>	<b>MAXIMUM NO. OF STUDENTS / EVENT</b>	<b>MINIMUM NO. OF STUDENTS / EVENT</b>	<b>MODE OF STUDENTS / EVENT</b>
<b>FALL '16</b>	30	2.5	81	1	1
<b>SPRING '17</b>	28	1.5	37	1	1
<b>FALL '17</b>	87	1.4	50	1	1
<b>SPRING '18</b>	65	2.0	17	1	1

Student participation per semester varies because of the changing number of students enrolled and because of the changing number of events offered. The School of Engineering is making an effort to increase service and PD offerings, especially as enrollment is increasing and more students need more hours. Variation in events occurs because of the availability of events in the fall and spring. Continuation of data tracking will occur to identify the highest and lowest attended events.

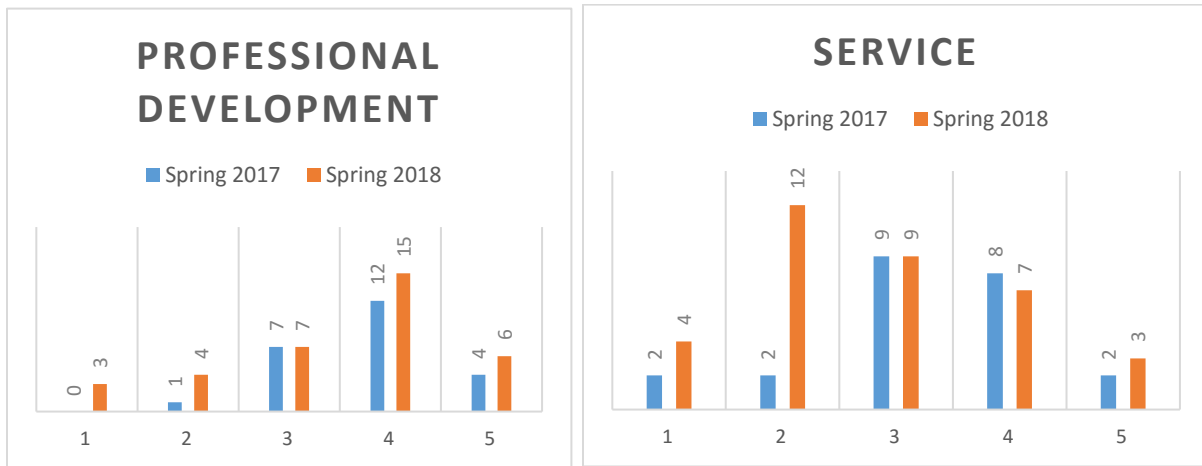


Figure 1. Survey responses to prompt “[Activity] events made me feel more like an engineer.”

Figure 1 shows student survey responses to the prompt “[Professional Development or Service] events made me feel more like an engineer.” Responses were given on a Likert-like scale with 1 as the lowest response (strongly disagree) and 5 as the highest (strongly agree). Students reported that they felt more like an engineer from taking part in professional development events as compared to service events. In addition, student anecdotal data indicates that the PD events were more fruitful in developing skills than the service events. Several students have commented favorably on the series of PD events we offer in the fall to prepare for the student career fair. These include a resume workshop, a networking workshop, and a workshop on how to work a career fair. Students at the career fair have earned several internships, and they attribute their experiences to these PD workshops. Students who attended several PD events for professional organizations also continued with the organizations in the future. Initially when students attended an event, they were there just for the PD hours. After that initial attendance, however, relationships started to form and they became more involved with the organization. Students became more involved and attended events that were not available for PD or service because they became members of that professional community.

### Conclusions and Future Work

Across the two years of service and PD offerings, there has been an increase in both the number of professional development and service events offered. Students report enjoying the PD workshops on resume writing, networking, and other skill-building activities. Students do not feel as positively about their time spent on service activities. This has prompted changes in the service opportunities that are offered to students to focus more on engineering-specific service

and discussions of why the service is important to the engineering department. Additionally, the PD events are reported as being more helpful long-term, as students join organizations and build relationships because of their initial required attendance.

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**Jacqueline Gartner**

Jacqueline Burgher Gartner is an Assistant Professor at Campbell University in the School of Engineering, which offers a broad BS in engineering with concentrations in chemical and mechanical engineering. Campbell University started the engineering program in 2016, and she is leading the design and implementation of the chemical engineering curriculum at Campbell's innovative, project based pedagogical approach. She has a PhD in chemical engineering from Washington State University, where she specialized in miniaturizing industrial systems for applications in the undergraduate engineering classroom.

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Anastasia Rynearson is an Assistant Professor at Campbell University in the School of Engineering. She has worked on the PictureSTEM project as a graduate student and Postdoctoral Research Assistant through INSPIRE in the School of Engineering Education at Purdue University. She received a PhD from Purdue University in Engineering Education and a B.S. and M.Eng. in Mechanical Engineering at the Rochester Institute of Technology. Her teaching experience includes outreach activities at various age levels as well as a position as Assistant Professor in the Mechanical Engineering Department at Kanazawa Technical College. Her current research interests focus on early P-12 engineering education and identity development.

**Lee Rynearson**

Lee Rynearson an Assistant Professor of Engineering at Campbell University. He received a B.S. and M.Eng. in Mechanical Engineering from the Rochester Institute of Technology in 2008 and earned his PhD in Engineering Education from Purdue University in 2016. He also has previous experience as an instructor of engineering at the Kanazawa Institute of Technology, in Kanazawa, Japan.