

I Know What You Were Trying to Say- An Analysis of Online Messaging of Colleges of Engineering

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I Know What You are Trying to Say

Abstract

With declining enrollments and increasing competition for students, many universities are turning to social media to outreach to potential students. Social media has been found to perform an essential role in shifting sentiments, moods and overall image a university portrays [1]. This study examines the forward-facing presence of university engineering programs at two public universities. This study uses content and textual analysis and the lenses of occupational demography and feminist post-structuralism to make sense of the messages the programs are portraying to potential students and other stakeholders about the student experience and learning outcomes valued by the university. The study examines social media posts on Instagram, LinkedIn, and Facebook, as well as the university website and publicly accessible policies and curriculum requirements. By examining the messages portrayed on the internet, a sense of the student experience and commitment to the students, in particularly women, can be understood. This is then compared to enrollment data, and student success data to develop a picture of the effectiveness of the social media and if the university's mission is properly being conveyed. Two large, public universities (R2 and R3) that are primarily teaching focused, Minority Serving and with a large population of both first-generation college students as well as Pell grant recipients make up the study.

Overview

The California State University system is one of the largest in the country made up of 23 regional campuses and enrolling approximately 461,000 students. This is down from its peak enrollment in fall of 2020 when the system had 485,550 students enrolled. The enrollment decline of about 6.5% [2] is at a time when the UC system has grown 3.2% in enrollment and the California Community College system has rebounded to over its pre-pandemic numbers. This is a huge blow to the system and has led to multiple of the campuses being put on alert that they will combine with other campuses or face the possibility of closure. The majority of California's college going population will come from a group more diverse than other generations. This group will be comprised in a larger percent of students who come from a historically underserved population [3]. To make matters worse for the field of engineering, the CSU system lags behind the national average in number of degrees awarded and the percent of degrees awarded to women in engineering [4]. Cimpian and King found [5] the gender disparities in physics, engineering and computer science has diminished are more prestigious universities yet the gap in degrees in PECS to women at less selective universities (Average SAT math about 500), like the two in this study, has grown. Universities and the college of engineering must be more strategic and use different avenues to reach out to women, in particular women of color, to attract them to the university.

Brown et al, found that student use social media to express and develop aspirations of higher education [6]. They continue that this is even more important for groups who are historically marginalized as social media provides access to resources student may not have through traditional methods. However, Sandlin [7] found that students have a perceived authenticity of

social media posts with helps them to develop a connection to the university and explore an identity as a college student. Those posts that are not seen as authentic will discourage this engagement [8]. Brown also found that interaction with social media falls within the constructs of Perna's College Choice framework [6]. They found that students engaged with and had more connection to posts about student life as opposed to those specifically directed at recruitment.

Social media plays an important role in the matriculation of students and the first development of a relationship with the campus. Students use the lens of social media to develop a sense of the student experience on campus. Social media allows students to think about how they could see themselves interaction on the campus.

Research Questions

What is the message social media and online presence of universities are conveying? Does that message match the mission and vision of the university? Is that message welcoming to perspective female engineering students?

Review of Literature

The CSU

The CSU system was established to educate the top 33% of the population of California (the UC is the top 12.5%). The regionality of the campuses and preferred enrollment of local students is to promote an education of the surrounding community of the university. Ideally, this would allow for the demographics of the university to reflect the area it serves. As a system, the CSU has ABET accredited engineering programs at 16 of its 23 regional campuses. These programs trail the national average for degree attainment by women in engineering. System-wide only about 17% of degrees in engineering are awarded to women [3]. The low rate of women attaining engineering degrees at CSU campuses is influenced by several factors. Bowman highlights competition between the UC and CSU systems for students, a heavy reliance on community college transfers, and a limited range of locally available degrees, all of which can restrict women's participation at CSU [1]. With a system wide decrease of over 20,000 students, and only 6 campuses meeting enrollment targets, while the other California University systems are thriving, it is time to restructure how the CSU looks at recruitment and retention of students, in particular those from non-traditional groups to sustain viability and grow system-wide. It is not longer enough to be local and available, intentional efforts must be made to increase enrollment.

Enrollment of women in engineering

A diverse STEM workforce means a better match for the customer. However, many degree fields seem to have leveled off in the awarding of degrees to women [10]. This is abundantly clear in the CSUs. Many studies have found that women are one third less likely to enter the field of engineering [11, 12, 13, 14]. This could be because women have a lower math self-concept than their male counterparts [11]. Cimpian found that working with people similar to oneself allowed people to enter a field at a higher rate and avoid tokenism [5]. Even with the continued encouragement from parents or teachers, women tend to fall into a more traditional gender norm when in classes with male counterparts taking over lab experiments pushing women to more rote

chores [15]. A feeling of disengagement from the field is not uncommon. Previous work has found that humanistic work or community driven work encourages women to persist in the field of engineering [10]. Identity ownership and authentic engagement is key to encouraging women to enter into and persist in the field of engineering [15]. This identity formation begins before students arrive on campus.

Social media and the university

Social media is a way students interact with the university during the recruitment process and beyond. Students can get a sense of what the student experience is like at the university by the messages and posts displayed through its online presence. Social media fills a very important role for students, especially those from historically marginalized groups to build a connection to a university. Brown et al found that students can build college aspirations and challenge overriding presuppositions of who participates in higher education [6]. Brown continues to show that interaction with online presence follows Perna's college of choice framework. Students feel more connected to the university when they can interact with posts about the student experience. This contrasts with directed recruitment posts which students felt less of a connection to [8]. Sandlin and Pena found that students had a level of perception of the authenticity of a post by a university. Authentic posts about the student experience lead to students forming a connection to the university which allowed them to explore. This exploration led to the formation of an identity as a student interacting with those featured in the posts. Students wanted to interact with those who they saw as their peers (or near peers) [7]. Online presence allows a university to develop a sense of community and for students to build a virtual social network to be translated into an actual connection to the school once enrolled. Students can build a virtual network that can be leveraged into an in-person network to encourage enrollment in nontraditional careers [9].

Theoretical framework

Organizational demography refers to the study of the composition of an organization in terms of various demographic characteristics, such as age, gender, race, and tenure. These demographic features impact organizational behavior and performance, particularly through social interaction, communication, and decision-making processes. Organizational demography offers a lens through which to analyze how diversity, particularly in terms of underrepresented groups, influences organizational structures, practices, and outcomes [16]. This framework is particularly pertinent to understanding the intersection of demographic factors within academic environments, such as engineering colleges, and their impact on the broader organizational and cultural contexts.

Individual attributes such as race, gender, and age—can influence how individuals interact within an organization, as well as how the organization itself functions and evolves. In the context of higher education, particularly engineering, demographic characteristics, such as the representation of women of color, may influence student experiences [16]. This theoretical perspective helps to frame the idea that organizational outcomes, such as the inclusion and retention of underrepresented groups, are deeply connected to demographic compositions at various levels of the institution.

Using this framework, Main et al, [17] found universities that award the most degrees to women, particularly women of color, are more likely to employ women of color. The integration of organizational demography with cultural models provides a nuanced understanding of how the demographic characteristics of faculty, students, and staff influence one another. It underscores the importance of both structural representation and cultural attitudes in creating environments that are truly inclusive. [18]

The insights derived from this framework will contribute to understanding how universities can foster environments that not only attract a diverse body of students but also ensure the inclusion and success of underrepresented faculty members, ultimately benefiting the institution as a whole.

Using the Feminist Poststructuralism constructs to make a complete the understanding of issues in enrollment trends of women in undergraduate engineering programs the issues that are uniquely feminine. Weedon explained that by not looking at all four constructs of Feminist Poststructuralism, the meaning to women and invisible factors of the experience were lost. These constructs include Power, Language and Discourse, Common Sense, and Subjectivity and each gives a dimension to the experiences of marginalized groups in the field [19]. These dimensions of identity and existence in a field look at the sociocultural aspects of experience that cannot be quantified on a survey, SAT score, or grade. Instead, the frame gives a window into the lived experience of women. They continue “feminist post-structuralism troubles the binary categories male and female, making visible the constitutive force of linguistic practices, and dismantling their apparent inevitability” [20 p. 321]. Without a frame that looks to gender to inform practice and reality, there is no way to uncover the dichotomy that exists within the field of engineering.

Methodology

This study examines the messaging sent by two public universities in California (one R2 and one R3) uses a mixed method approach of both quantitative and qualitative analysis. The content analysis, a systematic research method for analyzing communication materials. As defined by Riffe [21], content analysis involves categorizing and interpreting the content of communication in a structured and reproducible way. This study also uses textual analysis, a qualitative research method that involves interpreting the meaning and significance of texts within their cultural, social, and historical contexts [22]. McKee's approach, this analysis focuses not only on the content of the posts but also on the ideological, linguistic, and cultural factors shaping and influencing the posts. This research aims to analyze social media posts from both colleges of engineering to explore how they communicate with their audiences and reflect institutional priorities, values, and responses to current social, political, and cultural issues. Specifically, the study focuses on Instagram/ Facebook/X (as the posts are the same for each) as well as LinkedIn and the university college website.

The Universities

The two universities in the study are public universities with ABET accredited engineering programs. Both universities are Asian American and Native American Pacific Islander Serving Institution (AANAPISI) and Hispanic Serving Institution (HSI) designated. One of the

universities is an R2 and the other is R3. Between the two colleges, they welcomed over 2,000 first time freshmen during the fall of 2024 and over 12,000 total students during the same period. For reference, at the beginning of the period of analysis, the colleges enrolled about 11,500 students to the colleges of engineering with approximately 2,000 of those students being first year students. Demographically, the R2 (University 1 in the table below) university enrollment in the college of engineering is about 23% up from 20% in fall of 2020 and for the R3 (University 2 in the table below) is about 19% down from about 21% in the fall of 2020. When enrollment is considered, the universities enroll about one-tenth of the female students who are accepted to the university across all majors.

Table 1 Enrollment data for universities

	% women 2020	% women 2024	Enrollment yield non- URM women 2020 (all majors)	Enrollment yield URM women 2020	Enrollment yield non-URM women 2024	Enrollment yield URM women 2024
University 1	20%	23%	13.7%	20.7%	11.8%	20.2%
University 2	21%	19%	10%	19.3%	7.3%	12.4%

Unit of Analysis

The unit of analysis for this study is individual social media posts made by the colleges on Instagram/Facebook/ X during the period of 2020-2024. Each post represents an instance of institutional communication intended for public consumption. These posts include text, images, videos, and any embedded links that convey messages about the university's values, activities, announcements, or responses to external events. To code and tally the people featured in the posts, we mimicked the experience of a person consuming the online presence at face value. Gender and whether the person is of a traditional URM group, as defined by the CSU system, was inferred from the post. When possible, surnames and any other identifying information in the captions were used to decide. The analysis also focuses on the hashtags used to convey importance of the posts. Each caption was tallied for their content based on the code list established by the team. Posts were tracked by the protocol in table 2 below.

Table 2: Post Tracking Protocol

Post details: Photo: Number of pictures / Video Length: Date: Type of post:	Number of people in the post presenting as Non-URM Male	Number of people in the post presenting as URM Male	Number of people in the post presenting as Non-URM Female	Number of people in the post presenting as URM Female	N/A Scenery posts
Celebratory					
Students working in class					
Students in a lab					
Students directly working with a professor					
Alumni spotlight					
Student club					
Professor only					
Students speaking directly on a topic					
University general (not engineering specific)					
Hashtags if present:					
Caption (see code list)					

After all the data was gathered, it was analyzed through the lens of organizational demography as well as Feminist Post-Structuralism.

Results

The images and words, especially hashtags, were coded in two ways. The type of post/ image was first considered. These were coded into six main categories: celebratory, either student or faculty, like a graduation or club win; Students working in class, typically this means a lecture hall; Students in a lab, this can be outdoors or factory as well; Students directly working with a professor; Alumni spotlight; Student club/activity and meetings for clubs; Professor, faculty, and staff only including leadership not necessarily celebratory; Students speaking directly on a topic; and University general (not engineering specific). When the text and hashtags were considered and coded four major focuses of the text arose: Advancement; Project-based Learning/Hands on learning; excellence; and broader impact. Each hashtag was categorized into the four categories but also examined by their frequency to make a deeper understanding of the priorities of the college.

College of Engineering Webpage

A one-time analysis was completed on each College of Engineering (CEO) websites. The language and images/ videos were analyzed to convey the values of the college and the focus of the institution.

Figure 1: Demographic characteristics of COE websites

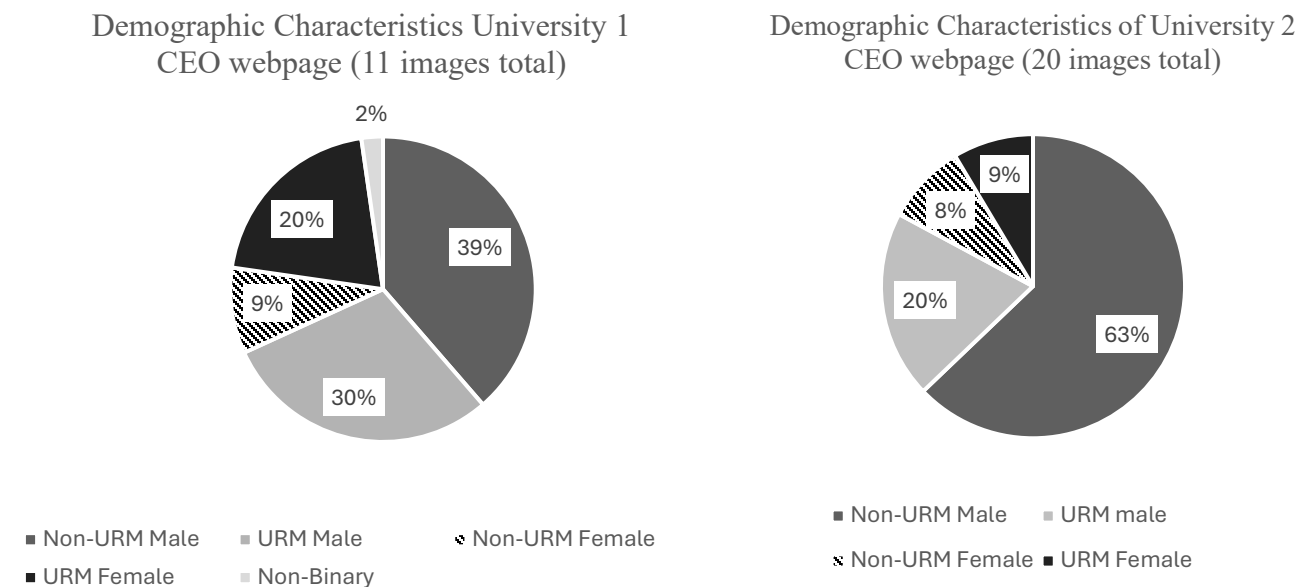
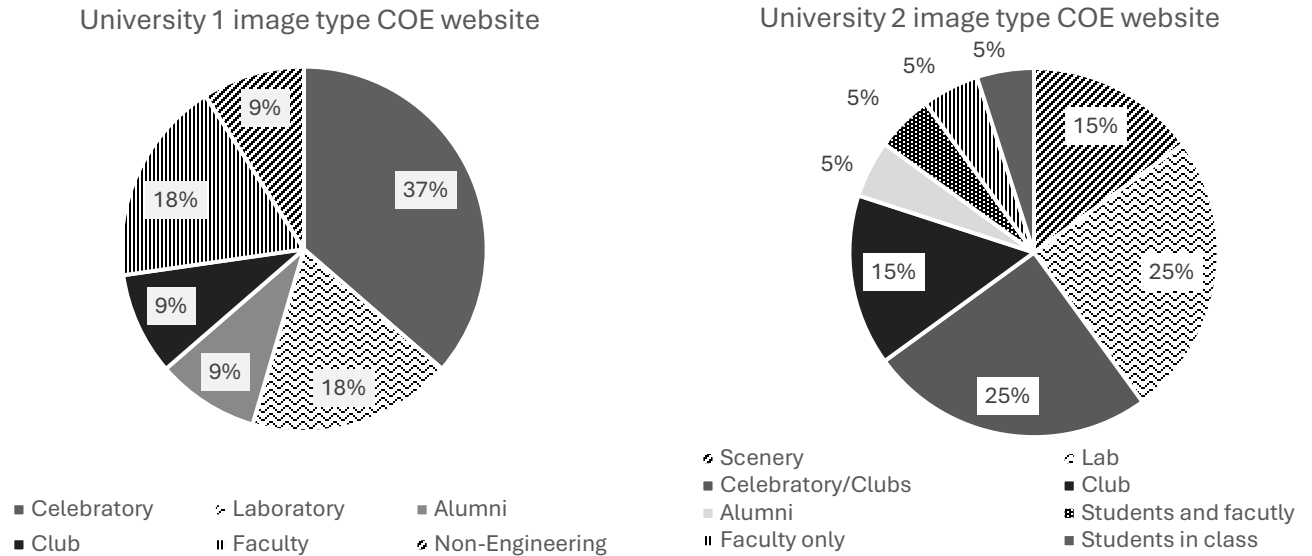


Figure 2: Image types COE websites



University 1:

University 1 had 11 images/ videos on its college homepage. There was more extended news feeds and thumbnails that were examined in this analysis but not included. The demographics in the images are male presenting non-URM: 17; male URM: 13; female non-URM: 4; Female URM: 9; Gender non-conforming: 1. This is shown in figure 1 above. Figure 2 shows the type of posts (by percentage) on the COE website. The intersection of these figures is shown below in table 3.

Table 3 College of Engineering website posts University 1

Type of image	Demographics
Celebratory	URM male
Project/ student lab	6 men
Students working alumni	URM female
Professor award	URM female
Student club	8 URM male, 11 non URM male, 2 URM female, 1 non URM female
Celebratory student award	1 gender nonconforming 1 URM male
Celebratory	3 URM female 1 non URM female
Celebratory	3 URM male, 1 non-URM female
Faculty alone	1 non-URM female
Students working lab	1 URM female

When the text is considered, there were each of the textual codes found on the website. Some of the text coded as advancement included: innovations of tomorrow; mobility; changing the world. Excellence was coded for the quick university facts and impact of the field among others. The words project-based learning was coded in conjunction with industry partners. Finally broader impacts were coded for transforming communities, racial justice and others. When the intersection of the code groups is considered, there were strong overlap with broader impact and each of the other codes. Most of the text discussed transforming communities and building diverse solutions to problems. Each code was cross-coded with broader impact for this webpage.

University 2:

University 2 had 20 images and videos present on the homepage. These images included 22 non-URM males; 7 URM males; 3 non-URM females, and 3 URM females. This is shown in figure 1 above. Figure 2 shows the type of posts (by percentage) on the COE website. The intersection of these figures is shown below in table.

Table 4 College of Engineering website posts University 2

Type of image	Demographics
Scenery	None
Scenery	None
Lab work	None (hand only)
Students working in a lab	One URM female 2 non-URM male
Student in a lab	1 non URM female
Students working with professor	1 URM female, 3 non-URM male; one non-URM male professor
Professor alone	1 non-URM male
Student working in lab	1 URM male
Engineering general (no people)	None
Student activities	None
Celebratory	URM male
Student in class	Non-URM female
Students in a lab	1 URM female 2 URM male
Alumni couple	Non-URM male and female
Student club/ activity	2 non-URM male
Student club/activity and Celebratory	5 non-URM male
Student club/activity and Celebratory	9 non-URM male
Student club/activity and Celebratory	No people
Student club/activity and Celebratory	3 non-URM male

When the text was coded, each of the four categories was present again, however broader impacts was only coded twice on the page. Broader impacts was coded with regards to social mobility and solutions for society. Excellence was the most prominent code on the page with examples like world-class, top ranking, in demand, and ahead of peers. The next most common code was project based/ hands on. Examples of this code included student innovation, industry standard equipment and student projects in general. Project based was always coded with excellence. Finally, advancement was coded with words such as realize potential, in demand graduates and new solutions. These were often coded with excellence but not always. When the intersection is examined, it is clear that excellence coincides with the rest of the posts but not necessarily vice a versa.

Both college of engineering websites highlight student project-based learning and celebrate the accomplishments of their students. Of the people represented on the webpage, University 1 shows 31% women (over representation of the enrolled) and University 2 shows 17% women (an underrepresentation of the enrolled). When the tone of the language and the codes present are considered, University 1 focuses on social impact and lifting communities, while University 2 focuses more on cutting edge technology and world-class education. Both universities also feature their respective aerospace department more than other departments. This trend is more prevalent at University 2.

Social media posts

The social media accounts were analyzed for the period of January 2020 to December 2024. The frequency of social media posts was first tabulated. Posts that may be archived or were not available during the analysis were not considered, this would best recreate a student's experience with the online presence.

Table 5 Number of posts on social media sites by university

	2020	2021	2022	2023	2024
University 1	236	284	180	32	5
University 2	168	91	30	12	77

There were many months at each university where there were no posts available. On average, University 1 posted $19 \frac{2}{3}$ posts a month over 12 months in 2020, $23 \frac{2}{3}$ posts a month over 12 months in 2021, 15 a month over 12 months in 2022, 4 a month over 8 months in 2023, and 2 per month over 3 months in 2024. University 2 posted on average 14 posts a month over 12 months in 2020, 9.1 per month over 10 months in 2021, $3 \frac{1}{3}$ posts per month over 9 months in 2022, 2 posts per month over 6 months in 2023 and $8 \frac{5}{9}$ posts per month over 9 months in 2024. One hypothesis of the team was that posting would increase during recruitment time (August through November). That does not appear to be the case with the exception of University 2 for the 2024 calendar year. They posted about 5 more posts per month during these months.

University 1 Findings

University 1 had varying degrees of usage over the four-year period. This is partially due to the COVID-19 shutdown. Over the four years 400 of the 737 total posts were informative fliers. These fliers were for club meetings, workshops, or job talks. There was not context of text given with these posts. That is to say, there was no text or hashtags give. There were no students or people in the posts. 57 of the posts were celebratory. These called attention to the achievements of faculty and students. 32 of these posts were students focused, most of them graduate posts during the pandemic. The remaining 25 celebratory posts featured faculty advancement and accomplishments. When they were coded for the text, they coded excellence with broader impact, or just excellence. Nearly every post where people were featured in the post included a traditionally marginalized group.

To get a closer look at the more recent student experience, the last two years were examined more intently. Of the 37 posts in 2023-2024, 23 of the posts were informational fliers. Some of these indicated a focus on broader impact and attention to DEI issues. Two of the posts were celebratory for students and 3 were celebratory for faculty. All the celebratory posts were coded for excellence with words such as "testament to hard work". There is one alumni post featuring a woman of color. This post was coded excellence and broader impact. Four of the posts were about students in a lab. The text coded as excellence with all but one coding for broader impact as well. One post about a student club featured pictures of women of color only and focused on broader impacts of DEI issues on campus. Two posts were about community events hosted by the college. One was focused on broader impact (young women students) and the other was

overall excellence of the school. The remaining posts were faculty and if text was included, the text was coded as excellence. When examining university 1, there were no posts that reflected advancement and while some of the images coded as hands on learning, the text did not reflect that. Regarding majors, the posts are spread across the majors of civil, aerospace/ mechanical and biomedical. There are other majors at the university.

University 2 Findings

With the large amount of consist posting, a deeper dive was conducted over the years of 2023-2024. There were 89 total posts from January 2023- December 2024. Thirteen of the posts were celebratory. These included 28 URM men, 13 non-URM men, 19 URM women and 3 non-URM women. All of the texts from these posts were coded as excellence and advancement, except 3 posts about scholarships which were coded excellence and broader impact. Ten posts were alumni spotlights including six non-URM men, five URM men, and three URM women. In 2023 the alumni posts were coded as excellence and advancement. This changed in 2024 when the alumni spotlights also included discussion on broader impact. There were 15 posts of scenery only around campus. Those posts included a text caption that was coded as excellence and those of buildings also included the code of hands-on learning. Student clubs and activities accounted for 23 of the posts. These were coded as excellence and hands on learning. Twenty-two of the posts were students working in a lab with and without a professor. Again, these were coded as hands-on learning, and excellence. Seven of the posts were students speaking on a topic, 8 were faculty speaking on a topic and the remaining were students engineering non-specific. Most of the posts with students were coded as excellence and hands-on learning.

When discipline is considered, there is a discrepancy of what is posted by the college. There were no posts referencing six of the engineering majors. Only a few (less than 5) referencing two other majors. Most of the posts were focused on mechanical and aerospace engineering. This is also true about the clubs that are featured with students talking about them and the student activity posts. There is also a discrepancy between department when descriptors are considered. Faculty and posts about mechanical and aerospace engineering are described with superlatives such as brilliant and excellent while other department are not given descriptors at all. Posts around these departments is almost entirely male in its representation. By in large, university 2 gives much of its focus to the student experience- focusing on the excellence of the program and the hands-on aspects. The posts are largely male with the most diverse posts being the celebratory posts and those that are the university in general- engineering non-specific.

Discussion

The findings suggest that the messaging for the online presence of both universities is mostly consistent. The tenor of the college webpages is largely matched with the social media. University 1 appears to have a focus on holistic engineering, uplifting communities, and excellence. The professors and faculty highlighted on their online presence are largely from traditionally marginalized groups in the field and there is a distinct focus on having women and women of color in their posts. While not the only reason, there has been an increase in the enrollment of women to the program by 3% and an overall increase in enrollment. This trend

mirrors Brown [6] and Main [17]. The online presence gives students aspirational capital and the reflection of faculty and staff of non-traditional groups helps find a fit. The limited nature of the online presence and the lack of student-centered content gives the indication that the posts are to serve as informational for current students. The outreach aspect of the social media is very limited. The university would be served by engaging future students and showing the student experience.

In contrast, the online presence of University 2 is nearly entirely to showcase student experience. The vision of the university is that of programmatic excellence and hands-on learning. There is little discussion around broader impact of the field and even less connection to the community outside of campus featured. The website is focused on excellence and advancement with some hands-on learning featured, while the social media is focused on hands-on learning and programmatic excellence with some advancement featured. There is an uneven representation of majors at University 2 showing the value or ranking of the majors. This is reinforced by the language used to describe student projects and professors from the departments. If further research into the university was not done, one might think that there is large aerospace and mechanical engineering departments and a very small civil and chemical engineering department. This is not the case. Finally, there is an under representation of women on the social media and website. This trend became more prevalent at the end of 2021 and has continued. Something that the university holds value, students in a lab features 32 people in the posts, only 5 of them are women that is 15% which is lower than the enrolled percentage of women.

Both programs have room to grow and positive characteristics to build on. University 1 could add student experience to their social media, so students know what it is like to attend school as an engineer. University 2 could add a more equal representation of women to the posts and show a more even distribution across majors as to representation. Both could focus on the larger campus and interaction with the community in a more direct way. The competition for students in the state is tough and reaching a broader, more diverse audience would ensure more interaction with the campus and building of a virtual social network before students arrive on campus. Intention and authenticity is key.

These action steps can be extended to other universities who are trying to increase their recruitment of students. In this case, University 2 is falling behind on their outreach to women. There is also an over representation of two major meaning that students interested in other majors are left thinking the university does not have these majors or equally as bad, does not value the contribution of these majors. University 1 has a well flushed out webpage, but the social media presence is non-existent leaving students to wonder about the student experience.

Next Steps and Future Research

To complete the picture of student experience, the findings of the study will be compared against actual student experience. We aim to conduct focus groups on each campus with two different groups of students. The first groups will be first year female students, and the second groups will be upper division female students. Students will be shown images from the study and ask if the images reflect their experience at the university.

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