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Board 95: Exploring an Engineering Student-Centered Approach to Library Outreach and Engagement by Listening First

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Exploring an engineering student centered approach to library outreach and engagement by listening first

When it comes to University engineering departments, student expectations, and student experiences, change is a constant. Pandemic driven shifts to and from remote learning have exacerbated uncertainties and speed around these changes. In a recent effort to re-establish a relationship between the Engineering department and University Library, the library adopted a user centered approach to build connections and establish relationships. Contrary to an "if we build it, they will come" approach, this strategy prioritized a series of interviews and focus groups with students, staff, and faculty within the division. This listening first approach has helped us prioritize library resources in response to demonstrated curricula, research, and scholarship needs, many of which have changed over the past three years. This case study examines student focus groups and interviews. Major takeaways include new knowledge of student research practices, detailed insights from minoritized students, transfer student challenges, approaches to classroom accessibility, and greater curriculum awareness. This data has helped the library identify challenges unique to each discipline within the division, as well as potential gaps in undergraduate and graduate student support prior to initiating service.

Introduction

The foundation of this case study rests in user-centered research with the primary goal of learning more about the needs of engineering students at a R1 research institution. The study began during the Spring of 2022 when this researcher began working as a library liaison to the School of Engineering, filling a position that had been vacant for several years. During those years, the School of Engineering (SoE) had grown and changed, adapting to new technologies and curricula. A global pandemic had upended familiar classroom structures and student expectations. The library viewed any engagement with the SoE as a "fresh start" in terms of their relationship but wanted to make the engagement as meaningful as possible. To do that, the library needed to re-build our understanding of the SoE, students' lived experiences, what students considered research, how they learned best, and what they viewed as challenges to their process. We needed to listen first.

We describe this user centered approach as a "Listening First" strategy, since our research relied on broad, open-ended questions as opposed to surveys with predetermined answers or scales. The primary goal for the Listening First research strategy was to make sure students within the SoE felt listened to, valued, and included in the process. Meeting the primary goal could help develop reciprocal connections between the library and SoE, and could promote a sense of partnership between the two. Secondary and tertiary goals for the Listening First strategy include a deeper understanding of the research and publishing behaviors of students, as well as identifying student support gaps. Understanding the research behaviors of students would

inform programming and service needs, influence instruction, and provide a much-needed baseline for the information literacy habits of our engineering students at our institution. Areas where students felt unsupported could be anything from lack of access to tutoring, confusion surrounding off-campus access, or unmet support for academic goals. What constitutes a gap was intentionally left vague for the purpose of this study so we could remain open to unanticipated student experiences.

Existing background information, as well as conversations with student support staff in the SoE informed our approach with students. Insights from senior librarians with institutional knowledge were also invaluable. Over the past ten years undergraduate enrollment within the SoE has significantly increased. There are just shy of five thousand students enrolled, four thousand of whom are undergraduates. With these new students come dozens of new faculty members, evidenced by new positions posted and lines codified. Engineering coursework is challenging – freshman admittance retention is below 80%, and the average time to degree completion hovers between four and five years. Additionally, the number of transfer students admitted has quintupled between 2010 and 2020, signaling potentially shifting student needs and expectations. Graduate students have several degree options and may be pursuing masters or PhD research. Graduate students engage in coursework as well as research and design projects. According to student support services, most graduate students complete coursework during the first year of their program.

Literature Review

Engineering students are a unique user group within the higher education landscape. Engineers don't research so much as they design. This pathway begins at the undergraduate level where engineering students are expected to devote their time to theory and problem sets. Information retrieval leans heavily on textbooks. Emphasis on efficiency means students are taught to find answers quickly, and potentially compromise the fit of a resource in order to quickly move forward to the next task [1].

A Listening First approach utilizes the basic tenets of user-centered research, or user-centered design. User-centered research is the process of gathering information about the users of a product or service in order to inform the design and development of future products or services. Typically, this process includes interviews, surveys, usability testing, or observational studies. Centering users in research is not new for libraries or engineering librarians, who have been striving to better understand their users for decades. This literature review highlights several variations of survey, interview, and focus group methodologies. Most focus on specific subgroups of engineering students, such as members of the LGBTQIA+ community [2] or English language learners [3]. Even without the confines of a degree program, finding a representative sample or moving beyond convenience sampling is difficult, so one unifying theme is small sample sizes.

When examining user centered research in engineering libraries, there are numerous examples of small studies focusing on students belonging to specific demographic groups, or the

impacts of specific services. Similarly, these studies relied on learning as much as they could from a necessarily small sample. Burrell et al., (2013) used focus groups to examine within-race stereotypes of Black engineering students at a HBCU [4]. Combinations of surveys and focus groups have netted comparatively higher response rates, as with a group of researchers at the University of Michigan's College of Engineering study unpacking engineering students' use and perceptions of etextbooks, including frequency of use, print or electronic preferences, and desired interface features [5]. In both studies, surveys were used to obtain basic use data and preferences, then focus groups unpacked the nuance of preferences.

Recently, researchers at CalPoly Pomona used surveys and focus groups to assess the utility of an online video tutorial library [6]. Specifically, they were curious about the impact of an educational video library on populations that were underrepresented, under supported, and had lower persistence rates than their peers. Change & Eskridge (2015) reported on a number of surveys, focus groups, interviews and observations to determine the space needs of engineering students at North Carolina State University [1]. Instructors at Pennsylvania State University used surveys and focus groups to assess the quality and effectiveness of first year seminar classes in the School of Engineering. Though not library-specific, the study did examine how the seminars influenced a student's study skills or their use of library technology. The answer was not very much – in fact, they found that 22% of first year engineering students had never used the library [7].

Engineering graduate students' needs tend to be quite different from their undergraduate counterparts. Many graduate programs assume students enter the program with foundational information literacy knowledge obtained during their undergraduate programs. However, this is at odds with our understanding of theory-heavy undergraduate programs. Previous research on graduate student populations indicates that confidence in their information literacy skills is high, but this confidence may not translate into practical skills [8]. A survey of Electrical Engineering and Computing students at the University of Zagreb found that graduate students still struggle with evaluating resources [9]. A study at the University of Michigan surveyed and interviewed graduate students in focus groups, finding that most students had a research query that would benefit from library engagement, and students were receptive to receiving it [10]. With respect to instruction modality, focus groups and surveys to interrogate graduate student research needs and learning preferences at a large R1 university, of which Engineering students comprised about 8% of the respondents, indicated that graduate students prefer on-demand or asynchronous research skill development [11].

Librarians at North Carolina State University approached user research as an ethnographic assessment, embedding themselves in engineering labs. During the study, librarians served as a point of need for resources, mentors, and instructors during lab meetings. This approach provided librarians with deep knowledge of their liaison area's research practices, but was limited in tracking how students, staff, and faculty responded to this exposure [12].

Outside of libraries, numerous studies have interrogated success and failures of specific engineering departments using user-centered models. Villanova University's Engineering program noted a comparatively high number of female graduates compared to the national average, and sought out students to help explain [13]. Focus groups surfaced themes of female

students noticing and appreciating high numbers of female faculty. High numbers of enrolled female students also meant community within the department was easy to find, which fed a sense of belonging.

Methodology

Undergraduate and graduate students were considered separately due to fundamental differences in curricular demands and degree outcomes at their respective stages. Undergraduate student focus groups were selected over one-on-one interviews in order to promote psychological safety among students and allow students with shared experiences to bounce ideas off each other. Aligning with IRB exemption requirements, all interviews and focus groups began with a summary of the research project, protocols, and confidentiality statements. With the pandemic still an ongoing concern, students were given the opportunity to select in-person, zoom, or outdoor interactions. Students were also asked for their gender identification, allowing researchers to create an affinity group of female-identifying students. This seemed important since women are underrepresented in the School of Engineering, and the profession as a whole.

Undergraduate students were recruited via an ad placed in the engineering department's newsletter highlighting a $25 gift card for participation. Compensation was part of an effort to increase the diversity of participants, and make sure students knew their time was valued. Forty-one undergraduate students responded with names, preferred pronouns, and the location they would feel comfortable meeting. Three out of four respondents (76 percent) were more comfortable meeting on Zoom, though some wanted to meet in person. From their responses, including time blocks they had free, invitations for three separate focus groups were sent out. One focus group was in person, two were on Zoom. Six students were invited to each focus group, and four students followed through with full attendance for a total of twelve students. Graduate students were recruited via advertisements in the engineering department's newsletter, and through direct email recruitment mediated by division liaisons. Recruitment ads highlighted a $25 gift card for participation. Eight graduate students representing different concentrations within the School of Engineering were recruited and interviewed individually. All requested Zoom interviews.

Student research assistants were recruited to participate in interviews and focus groups, primarily as note-takers. This allowed library researchers to focus entirely on the conversation, which was led by the librarian researcher with the aid of predetermined, open-ended questions about the students' experience (Appendix I and Appendix II). Undergraduate focus group participants were also asked to create an empathy map, a tool often used in UX research, for a hypothetical friend or colleague also in their program. They were asked to document what they imagined their friend's influences, goals, and challenges were. This allowed students to unpack difficult, possibly anxiety-producing topics with a layer of protection. At the end of the session, research assistants were encouraged to ask follow-up questions. Interview and focus group notes were then coded, allowing themes and patterns to be extracted.

Key Findings

Themes and patterns that emerged from the interviews and focus groups were broad and tremendously helpful as background for a librarian new to the SoE. Some key findings may be generalizable to other undergraduate engineering programs, but others are unique to this particular university and departmental context.

Undergraduate Focus Groups

Undergraduate students were very aware of the cost of their education, and resented when instructors assigned materials that would add to their out-of-pocket costs. Requiring students to use a subscription program when a free program existed, for example, or requiring clicker purchases for attendance when a sign-in sheet would be sufficient added more unnecessary stress to the students. Students valued hands-on learning experiences and real connections with instructors, TAs, and students. However, when technology is used in the classroom, it should be intentional and well organized. Post-Covid, students are outspokenly appreciative of course recordings, even if they are present in class. This emerged as an accessibility issue, as students discussed how issues such as language comprehension, exhaustion, and overall concept familiarity made them appreciate the ability to replay lectures. There are reports of vital course information being relayed during office hours, which sometimes conflict with other responsibilities. Burnout among undergraduates was a recurring theme in all focus groups.

According to respondents, students are overloaded with work, family, and school, so they must prioritize their focus day-to-day. They feel like they could always be doing more, and they reported very little time available for decompression and relaxation. Students who also had to work part-time jobs felt even more stressed and were more likely to take advantage of recorded lectures and office hours when they were working more hours. Planning course schedules for upcoming quarters is anxiety-provoking since the availability of classes changes from quarter to quarter, and instructor changes can impact the course content. Linked to SoE growing pains, programs are also subject to change, which puts students on guard.

Coursework is heavy, but students also feel pressure to do project work and research. Project and research experiences are uneven. Student experiences in labs depend on mentorship of supervisors within labs. Courses aren't structured to provide foundations for independent research. Empathy maps made it clear that undergraduate students' main goal was securing an internship, and having independent research or project experience made their applications stand out. The absence of built-in projects within courses means students must find time outside of their courses to build that experience, putting students who have to work part-time jobs at a disadvantage.

Each focus group highlighted similar themes and remarked on the same pressures. Students expressed different relative pressures in different disciplines. Students in Biomolecular Engineering, a smaller major on campus, reported more feelings of isolation. Computer science students, the largest SoE major, reported the most difficulty scheduling required classes. In the

woman-only focus group, students brought up imposter syndrome as a factor in their academic life, a concept which had not surfaced in other, mixed gender focus groups. Participants in the woman-only focus group also remarked on their reluctance to ask questions in class or to appear less competent than male peers. Seniors in that focus group acknowledged that as they moved through the program and built relationships with their cohort, they gained confidence and were less self-conscious. They also mentioned that being online was easier, since they didn't notice how few women were in each classroom. They could submit questions without drawing attention to themselves and find community in classroom instant messaging social communities, such as Discord. During the remote-learning phase of the pandemic, many instructors and teaching assistants set up class channels on Slack or Discord, which allowed students to communicate with each other outside of Zoom classes and collaborate on homework assignments. This practice still endures, and several focus groups noted that instant messaging groups made homework help seem easily accessible.

Graduate Interviews

Most graduate students interviewed chose their programs as short, intensive steppingstones to either a different graduate program or to boost their application to a nearby industry position. Proximity to these industries was a huge factor in selecting their institution. We learned that students admitted into the graduate studies program without a computer science background would likely struggle during first-year introductory coursework and teaching assistant responsibilities.

Students in the masters programs felt overwhelmed by coursework and teaching assistant responsibilities their first year and were then thrust into a research program with guardrails their second year. Those interviewed felt overwhelmed and underprepared for that transition, especially if their undergraduate degrees were in engineering. Shifting from a mostly problem-set based system to a comparatively self-devised study plan was an adjustment. In PhD programs, students have far more freedom to choose the direction they want to take their research, but still have questions about the research process. Several students interviewed expressed profound confusion regarding graduation requirements beyond coursework. Despite attending orientations during their first quarter as graduate students, many students are unaware of library services. The library was surprised to learn that publication was a very low priority for the graduate students interviewed, though there was slightly more interest from PhD students. Overall, even among PhD students, publication was not a top priority.

A resounding theme heard from graduate students was a sense of isolation and tenuous work-life balance. Students interviewed did not feel strong connections to their peers, labmates, or mentors. The strongest relationship emerged between graduate student teaching assistants and their undergraduate pupils. Graduate students that worked as teaching assistants remarked on the heavy time commitment and reluctance to "let down" their undergraduates by being unavailable, even outside contract hours. Students were interested in building stronger connections to their cohort and colleagues, but unsure how to accomplish that.

Discussion & Further Research

Given the sample size and rapid nature of the study, a sample of convenience could not be avoided. The sample size was small, and questions broad in order to help the researchers gain important background information. Intentionally structuring focus groups and interviews as conversations with open ended questions allowed students to discuss what mattered most to them, without allowing researcher assumptions to shift the focus.

A deeper understanding of the research and publishing behaviors of students, staff, and faculty emerged in both undergraduate focus groups and graduate interviews. Undergraduate students are more likely to approach research and design problems while working on extracurricular projects, working as lab assistants, or doing independent study. Librarians should not rely on coursework to provoke a need for intervention, since the need may emerge during students' extracurricular work. Librarians could also work with faculty who employ undergraduates or provide asynchronous materials. Graduate students seemed unaware of library services, even after articulating support needs. This indicates a failure in outreach, possibly due to the timing of library orientations. Since orientations occur when students are adjusting to graduate work and teaching assistantships, it's possible that students are simply overwhelmed and would benefit from more point of need interventions.

Potential student support gaps were identified as students discussed challenges in their programs. Undergraduate prioritization of internships and securing employment post-graduation has encouraged the library to collaborate more closely with campus Career Services to provide programming targeting resume builders and research practices outside the academy. Graduate students' experience as teaching assistants was associated with a great deal of anxiety – both due to lack of confidence with course content, as well as time management concerns. Instructors rely heavily on teaching assistant's availability, and many teaching assistants are not discouraged from working more than their contracted hours. These reports indicate a substantial gap in support for first year graduate students in SoE.

We learned that simple changes would be appreciated at all levels: recording lectures, providing asynchronous content, and allowing students to ask questions anonymously (such as on a jamboard during class). Providing extensive orientations early in either undergraduate or graduate programs may not be the best use of time or resources, since foundational curriculum in both levels leans heavily on theory and problem sets. The high numbers of transfer students reinforce that finding, since freshman interventions would miss a significant number of future seniors.

Future research is necessary to learn more about key aspects of the results that indicate potential opportunities for student support. Graduate teaching assistant programs, for example, emerged as cornerstones of the undergraduate learning experience, but as a source of stress for graduate students. Learning more about graduate students' experiences as teaching assistants may help identify areas where the library can provide support. We learned from undergraduate focus groups that research opportunities were varied and often extracurricular. It would be interesting to learn more about students' experiences and advisor expectations to gain a deeper understanding of the learning outcomes and research exposure provided by these opportunities.

The library may consider developing resources to serve undergraduate engineering students involved in specific projects, or services to address equity concerns stemming from the extracurricular nature of these research opportunities.

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Appendix I

Undergraduate Student Interview Questions

Procedure:

Welcome to this informal listening session, we are so very grateful for your participation.
The UCSC Library is interested in your experience as a scholar here at UCSC. We are here to ask questions about your time here and listen to your perceptions. Our goal is to learn about your experiences as students and find ways to better understand your needs.

There are no right or wrong answers, say what you feel. Only one person speaking at a time, please. The moderator (me) is here to edge the conversation forward, not weigh in, so please speak with one another. Some of the questions call for a round robin response, which means we can go around in a circle to answer the question. If you don't want to answer a question, feel free to pass. The audio is being recorded for transcription purposes but will not be shared publicly. If you're more comfortable chiming in via chat, go for it, nod your head, add thumbs up.

Guiding Questions:

1. What is your program (major, minor concentration), and why did you choose it? [Round Robin]
2. What makes a good learning experience for you?
3. What are some strategies you use to balance coursework and life?
4. For those of you who've completed a capstone project and/or a research paper, can you talk a little bit about the preparation you received that was most helpful and what you wish you knew before you started?
    1. How do you start planning your project? [draw how you start planning a project. Pair and share similarities?]
    2. Narrow down topics?
5. What are some strategies you've tried, if any, to finding belonging at [redacted]?
6. What are some strategies you've tried, if any, to finding mentorship at [redacted]?
7. Think back to where you were as freshman, and what you thought the program would be like. Now think about where you are now. What do you think incoming freshman students need to know about your program in order to be better prepared?
8. Think about conversations you've had with friends and other students in your program and around campus. Think about the kind of advice you give or have received when chatting about the struggle of coursework expectations or imposter syndrome? Now, imagine someone from your high school is starting?
9. What are some struggles you have encountered while completing assignments? What has been straightforward? [Round Robin] What would assignments look like if all your barriers to completion were removed?
10. What kind of paths are you considering after the completion of your degree? (e.g., grad school, industry, other)? Do you feel like the university is doing a good job supporting you on your path?

11. I'm interested in how you use campus resources – where do you go to focus? Where do you go to collaborate? Do you use SoE game labs or makerspaces? Do you work with the writing center? Are you involved with any clubs, organizations or institutes?
12. What is it that you think the SoE admin (or campus admin) don't understand about undergraduates and what is important to you?
13. Anything else you would like to tell us about?

Appendix II

Graduate Student Interview Questions

Basic Questions

1. What is your department or affiliation within SoE?
2. How many years into your program are you currently? About how many remain?
3. What was the most important factor that pushed you to attend [redacted]? Was it cost, proximity, research topic, culture, familiarity, etc?

Student Perceptions/Goals

1. Can you tell me a little bit about your work?
2. Can you describe your research process? How do you start?
3. What are some strategies you employ as a grad student to balance coursework, teaching, research, and life?
    1. How do you plan your days to meet your obligations?
    2. Are you involved in any extracurricular activities or student organizations?
    3. Any challenges you would like to share?
    4. What are some tools you use?
4. How has your approach to scholarship and research changed since undergrad?
5. What were you expected to know entering your program? Were there any "unstated expectations?"
6. What are the obstacles and challenges you have encountered in your research?
    1. How have you overcome these challenges?
    2. What is going well in your research process?
7. Do you/at what stages in your research do you engage with the library or library website?
    1. What resources or services do you use?
    2. What challenges have you encountered using the library?
    3. What do you do when you hit a paywall?
8. What types of data do you use in your research?
    1. What does data collection look like?
    2. How do you manage your data? Challenges?
    3. What is the culture around data sharing? Have you shared? Have you used someone else's data?
9. What does data collection, sharing, and management look like in your field?
10. Are you expected to publish during your program? Do you think publishing will help you reach your career goals?
    1. What are your perceptions of the publishing process?

Professional development

1. What is your desired professional outcome post-completion?
    1. How are you preparing for success?

      2. What is your approach to looking for mentorship or training in that space?
2. Do you engage with industry professionals in the area?
      1. If so, how? If not, why?
3. Do you feel the University has an adequate support system for your unique trajectory? For example, are there [redacted] workshops, or is your advisor well informed?
4. Do you serve as a TA or supervisor for undergraduates or more junior students?
      1. Can you describe your mentorship experience? How do you serve as a mentor?
      2. What do you tell undergraduates interested in pursuing a similar trajectory?
      3. Have you, or are you interested in, building your skills as an educator or mentor? For example, have you attended [redacted] workshops?

Closing

1. Is there anything you would like the library to know about your unique, personal experience as a student?