



## Help Seeking Among Undergraduate Men and Women in Engineering

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## 1. Introduction

In many ways, asking for help with a problem or new challenge runs contrary to an engineering ethos that values competence and independence. For instance, Leonardi and colleagues found that nearly every one of the 128 engineering students they interviewed expressed the sentiment that in order to learn fundamental engineering concepts and skills one had to work alone [1]. As one representative student commented “I think part of the engineering degree is really also being able to come up with things on your own—to be able to solve problems on your own.”[1] Seymour and Hewitt similarly describe how the competitive nature of STEM classes, which often pit students against one another with curved grading and class rankings, makes students reluctant to ask or provide help to their classmates [2]. Faculty seem to support this individualistic atmosphere by discouraging students from over-relying on faculty assistance and using teaching assistants or other resources instead [2].

Yet, asking for help when it is needed is critical to success in the workplace. Lifelong learning has been identified (along with teamwork and communication) as one of the key non-technical competencies engineers need to master [3], [4]. Lifelong learning is the continuous building of skills and knowledge throughout the life of an individual [5] and is particularly important in professions such as engineering that experience continual change in response to rapid developments in technology and regulations. Lifelong learning involves individuals transcending narrow domains of expertise by talking to others and sharing insights [6]. For students to develop these skills, they must be able to realize when a problem or task falls outside of their current expertise, actively seek knowledge from others, and understand how to obtain information from knowledgeable peers and mentors.

Organizations benefit when employees feel comfortable asking colleagues for help. For instance, changing the culture of high-risk organizations to encourage employees to ask questions and admit mistakes results in fewer accidents and higher productivity [7]. Moreover, college graduates rarely possess all the skills needed to be successful in their new jobs [8], [9].

Yet, newcomers often resist asking for help. A study of recent college graduates working at Microsoft Corporation found that these new employees waited too long to engage others in their problem-solving process [10], [11]. They wasted time by independently working on problems clearly outside the bounds of their knowledge and held onto the belief that they need to demonstrate their value by doing everything themselves without asking questions [10]. These employees would have solved problems more efficiently and learned more by asking a more senior colleague for information.

Asking for help can be particularly fraught for female engineers, who are often worried that their questions will confirm stereotypes about their gender as less competent with the technical skill set required in engineering. Researchers have found that female engineering students are often reluctant to ask questions, go to professors' office hours, seek help from Teaching Assistants, or even participate in support groups, for fear of being stigmatized as needy [12]–[15]. Such fears can interfere with students' abilities to reach their full potential in STEM coursework.

Understanding the factors that motivate or inhibit various groups of students from seeking help can help us understand how to design interventions that will foster student success. At the same time, such research can also help us understand if we are preparing students for the life-long learning that twenty-first century workplaces demand. The interview study below asks the following research questions:

- Where do students turn when they need help with their coursework?
- What factors encourage or discourage students from seeking help?
- How do these factors vary by gender or other demographic variables?

## 2. Methods

### 2.1 Participants

Participants in the study included 47 undergraduate engineering students ranging from their second year to their sixth year of study. The students were members of one of six American universities including one private research university, three public research universities, and two public non-research universities at locations across the United States. They included 32 females (68%) and 15 males (32%). Of the participants, 51% were White; 28% Hispanic; 11% African-American; and 11% Asian American. Most participants were juniors (41%) or seniors (43%) with the rest sophomores (17%). Overall, these students were academically successful: 23% had *high* GPAs (defined as 3.5 or higher); 40% had *average* GPAs (defined as 3.0-3.5); and 36% had *low* GPAs (define as lower than 3.0). All participants were native English speakers.

### 2.2 Interview Protocols

Interviews, which were part of a larger project on gender and interpersonal communication in engineering, were 75 minutes long and took place in a private room at the participants' campus. For one week prior to the interview, participants were asked to keep a journal chronicling any time they felt the need to complain or ask help. Interviews began by asking students some general questions about their study and then asked them to elaborate on one or two incidents in the journal. During the discussion, participants were explicitly asked who they went to when they needed help and whether or not they felt comfortable asking professors and peers for help with academic work. Participants were then shown some scenarios of common teamwork problems and asked about their process for troubleshooting teamwork issues. Participants were paid \$50 for their participation.

### 2.3 Survey

At the end of their interviews, students completed a modified version of the Persistence in Engineering (PIE) survey used in Altman et al 2010. This survey included a total of 70 items

that asked the participants about their motivation to pursue engineering, their experiences in their respective programs, and the likeliness of continuing their education or career in engineering. The survey also asked the participants for demographic data such as their ethnicity, economic class, and their parent’s education.

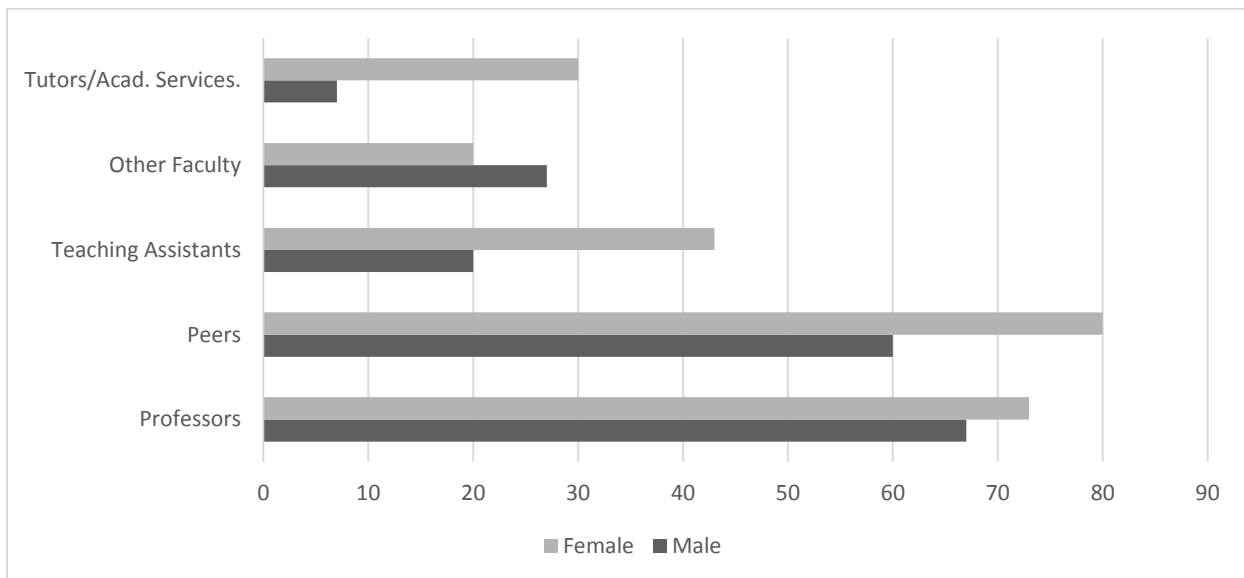
## 2.4 Analysis

Interview data was analyzed using MAXQDA software to find common themes using a modified Grounded Theory Methodology (Strauss). Once themes were identified, a more rigorous analysis was performed to identify which sources (e.g., professors, peers, teaching assistants) each participant mentioned seeking help from and whether students feared how they would be perceived for asking for help from these sources. We then cross-analyzed these variables with demographic information from the PIE surveys as well as self-reported data about students’ academic and social confidence.

## 3. Results

### 3.1 Women sought help from a greater number of resources than men.

Figure 1 shows that women made use of a greater number of resources than men. Women were particularly more likely to seek help from TAs, Academic tutors, and Peers. The only resource men used more than women was “other faculty,” which included faculty advisors, mentors, and department heads. While the majority of men in our sample reported using only one resource (usually either a professor or a peer), over 90% of the women reported using two or more resources ( $p < .01$ , Fisher’s exact test). This finding suggests that female engineering students generally seek help from more resources than their male peers do.



**Figure 1. Percentages of Men and Women Who Sought Help from Each Resource**

### ***3.2 Academically weak students expressed concern about how they are perceived for seeking help***

Many of the students we interviewed worried about how their professors would perceive them if they asked for help. Students with weaker academic skills were particularly likely to fear how their professors would perceive them. Of the students with GPAs below 3.0, 76% expressed perception fears compared to only 41% of students with high or average GPAs, a difference that is statistically significant ( $p < .05$ , Fisher's exact test).

We also found that students who self-reported low confidence in their academic skills were more worried about negative perceptions than students with high confidence,  $p < .07$ , Fisher's exact test. Students' perceptions of their academic confidence did not always correspond with their GPA. For instance, 30% of the students with low GPAs reported strong confidence in their academic abilities. Likewise, 30% of the students with high GPAs (all women) reported low confidence in their academic abilities.

There was no relationship between a student's self-reported social confidence or race and their fears of negative perceptions.

### ***3.3 Women expressed concern about how they are perceived for seeking help***

Consistent with prior research (e.g. Margolis & Fischer, Altman), the women we interviewed were more likely than their male peers to express a fear that their professor would perceive them as unintelligent or unprepared. Of the women we interviewed, 69% expressed a fear of being perceived as unintelligent or underprepared—or reported having overcome such a fear—compared to only 27% of men, a result that is statistically significant (Fischer's exact test,  $p < .05$ ). These fears can be seen in the following quotes:

Most of the time I'm very hesitant to go to their office. I do it, but I'm always scared that **they're gonna think I'm an idiot** when I walk back out. (*White Female, Average GPA*)

Sometimes, it's scary because I don't know things, and I don't know if I should ask. Because I know I'll have to ask cuz I need to know how to do it. At the same time, it's always thinking like, "Oh, **what if they think that I'm just a little baby?**" (*Asian Female, High GPA*)

I feel like if I do ask for help [the professor's] like, "Oh, why can't you figure this out? You should be able to get these problems...." **I kind of feel dumb** going to them and asking questions. (*White Female, Low GPA*)

I'm just worried that **they'll just think I'm so stupid**. I don't know. I feel like—I have liked engineering, but I feel like I have lost my confidence a little, in my academic abilities, sometimes. Just cuz they can be intimidating. (*White Female, Low GPA*)

I don't want them to **think that I don't understand at all** by coming to ask questions. (*African American Male, Average GPA*)

A few students explicitly linked their fears of how they would be perceived to their gender:

When I ask for help, **I feel kinda like if I'm weak. Then just being a girl studying engineering, I have more challenges than a guy**, so then I don't want people to figure out my weaknesses, just because it's much tougher for me than a guy studying engineering. (*Hispanic Female, Average GPA*)

Sometimes I feel like maybe—because I see **most of the students are boys and they are very—I don't know, maybe they get it better than I do**. Sometimes I'll feel maybe embarrassed to ask them questions, but I told them, “I might ask you some questions which maybe sound dumb or something, but I want to learn so I don't mind if you think that way. (*White Female, High GPA*)

Even academically successful women had perception fears. Of the women in our sample with a GPA of 3.0 or higher, 58% (n=11) reported fears (or having had fears in the past) about how their professors would perceive them for asking for help. By contrast, only 10% of men (n=1) with similar GPAs expressed such fears. Among students with GPAs below 3.0, 83% (n=10) of women and 60% (n=3) of men expressed fears about how their instructors would perceive their questions.

### ***3.4 Students had a range of strategies for overcoming fears that their professors would judge them for asking for help***

Despite fearing judgment for their questions, most students reported overcoming these fears in order to receive help from instructors. Many students reported feeling more comfortable after a positive experience with an instructor who reached out to them, encouraged them, or expressed a clear passion for teaching.

I really like teachers that are passionate. Then, you can tell. Especially, during office hours, or when I go to talk to them when I have an appointment with them, **they're very passionate about what they're teaching me. I don't feel any judgment, which is good.** (*Asian Female, High GPA*)

**There's teachers I feel I could just go up to cause of the way they approach us.** They're like, “Oh, just come over!” They're more student-friendly, I would say. Then there's professors who are like, “Eh, here are my office hours.” They don't really try; they're not enthusiastic about helping you. (*Hispanic Male, Average GPA*)

Others reported coming to the realization that it is the professor's job to teach them:

Freshman and sophomore year, I really was like I feel like I'm bothering them. **Then I realized we're paying tuition for them to teach us**, so they're supposed to help us. (*Hispanic Female, Low GPA*)

Several students noted a change in their professors' demeanor once they transitioned to upper-level courses. They described their professors as more approachable:

**Once I got into my higher division classes, that's when I felt like the professors wanted us to succeed** more than anything else. I'm guessing it's just because we've kinda crossed that line where there's no looking back. (*Hispanic Female, Low GPA*)

I took a graduate level class and for that professor I always felt like I could go into her office. She made herself very available. **I feel like I got more comfortable as my classes progressed in difficulty.** (*White Female, High GPA*)

In addition to developing positive relationships with some of their professors, students reported developing a number of strategies for asking questions. The most common strategy was to do as much of the work as possible in advance in order to form specific questions. Students stated that broad questions tended to produce unsatisfying results. Several students also reported writing down a list of specific questions in advance so as not to forget them:

I feel like that initial struggle where you're just sitting there by yourself is almost necessary so that **you can come up with a more specific question**... I usually try to stay away from those types of broad questions though. (*Hispanic Female, High GPA*)

I guess I just walked in and like, "So these are my problems," and **went through a list of questions I had prepared** and we just kind of went back and forth based on my list of questions. (*White Female, High GPA*)

Usually **I try to work out all the questions first** and try to understand what they're asking, so that way, I'm just not clueless when they're explaining how to do it. (*White Female, Average GPA*)

**I try to do all the work beforehand** so I can point out to him exactly what's going wrong and why I'm not understanding (*White Male, Low GPA*)

Other strategies students reported using included going to their professor's office hours with a peer and burying potentially stupid questions in with a list of more insightful questions.

When students prepare specific questions they feel more prepared and possibly more confident about asking their question. In turn, these specific questions may cause the professor to view the student positively—as someone who is prepared and motivated to do well. This perception may make professors more willing to provide help, which further bolsters students' confidence.

### ***3.5 Pride and independence prevent some students, especially men, from seeking help***

Nearly 30% (n=14) of the students we interviewed stated a strong preference to figure problems out themselves. Students often described this independence as characteristic of engineering students, a result consistent with prior research[1]. This sentiment was more commonly expressed by male students (40%) than female students (25%).

This independence benefitted many students, who reported they more fully understood the material if they figured it out alone. However, for some of our students, this independence manifested as a source of pride that prevented them from seeking help. These students were likely to report that they “never” sought help or only did so as a last resort:

I am comfortable with [asking for help], I just don't like to do it. I am fairly proud. I have done it on occasion when I didn't have a choice....**It's just a point of personal pride not to have to ask for help**...I want to be like I did this. I didn't need anybody else. (*White male, average GPA*)

It doesn't mean that I don't need the help, but **for some reason...I've never really gotten used to asking for help**. (*Hispanic male, average GPA*)

**I've never actually been that kind of student**.... If I had the time to learn [the concepts], I would be able to do them fine; I just don't have the time, sometimes. Essentially, going to a professor for help...that's never been the kind of challenge I've faced, if that makes sense. (*White male, high GPA*)

**I'm really stubborn and prideful on that**. I will not go to tutoring if I need help or if I'm having trouble on a problem, I'd rather just sit down and figure it out myself. Cause it's hard for me to [admit] “Oh, I don't understand what I'm doing” or explain myself properly for questions I need help on. (*Hispanic female, low GPA*)

One student who took pride in figuring out problems himself reported that the teamwork his curriculum now required was challenging him:

One of the biggest things that is very common among my friends and myself as well is ... we tended to be people that worked alone. We found a problem and we usually didn't [ask] “Can you help me out?” ... That was a thrill of solving the problem, doing it yourself....**You take so much pride in your work that you hardly ever want anybody else to have something to do with it**. (*Hispanic male, average GPA*)



While only five students in our sample stated that academic pride or independence prohibited them from seeking help, it is worth noting that four of them were male. Thus, 27% of the men we interviewed seemed to have an academic identity that precludes help-seeking. All four of these men stated that they were not afraid of how their professors perceived them—just that they were not the type of student who sought assistance from others. By contrast, the one woman who expressed this level of pride stated that she *was* afraid of how her professors would perceive her if she asked dumb questions. Thus, while the men’s independence seemed to provide them with a sense of accomplishment, the woman’s independence seemed to be a defensive mechanism warding off potential judgment.

### ***3.6 Under-represented minorities expressed more concerns that their peers would judge them for seeking help***

We did find some evidence that under-represented minorities (e.g., African-American and Hispanic) students were more concerned about their peers’ perceptions than White or Asian students. Nearly 40% (n=7) of the under-represented minorities we interviewed expressed concerns about their peers’ perceptions compared to 14% (n=4) of their majority peers, a marginally significant difference ( $p < .08$ , Fisher’s exact test). Tellingly, the only men who expressed concern about how their peers would perceive them for asking help were under-represented minorities.

Some of these students stated that they were *more* comfortable asking professors for help than their peers:

Of course, [other students] get way better grades than I do and it is kind of annoying because I feel like I work just as hard but I’ve gotten to the point where it’s like, “**All right, I’ll just go ask the professor.** You know what? I’m not these guys. I’ll deal with it.” (*Hispanic male, Low GPA*)

Some of them the material comes too easily to [classmates] that it’s really hard to ask them because it’s almost like they have to go so far back in knowledge that we should have gained two years ago or something.... **Usually I don’t convey as much about my grades or my understanding so they don’t really have anything to judge off** of if that makes sense. (*Hispanic female, Average GPA, Reported not caring about how her professor’s perceive her since it is their job to answer questions*)

There were no gender differences in students’ concerns about how their peers would perceive them for asking questions. GPA, academic confidence, and social confidence also did not affect whether students worried about how their peers perceive them.

Across our entire sample population, only 25% of students reported concern about how peers would perceive them for seeking help, although we should also note that this number may be low since we did not get a clear answer on this question from everyone we interviewed. However, it

is worth noting that even those students who expressed worries about their peers' perceptions had found study groups or networks of peers who could help them when they struggled.

#### **4. Discussion**

Our results show that, overall, students had a number of resources from which they sought help on academic issues. Most students had peers they felt comfortable going to with questions and most students reported seeking help from professors and other resources. These findings seem to suggest that engineering today is a more supportive and collaborative environment than Seymour and Hewitt found nearly two decades ago [2]. While this is good news, students still face a number of barriers to getting the assistance that will help them succeed in their studies.

Female students expressed fears that their professors would perceive them as academically incapable or underprepared for asking questions. Many students explicitly stated fears that they may be perceived differently because of their gender, a result consistent with prior research [14]–[17]. Although women appeared to compensate by seeking help from other resources (e.g. peers, tutors), their fear of judgment may prevent them from developing strong relationships with professors, a factor that may affect their retention in engineering [18].

Under-represented minorities similarly expressed concerns about how their peers would perceive them for asking questions. This finding is of particular concern since students overall used peers more than any other resource and found peer support especially valuable for providing immediate answers to questions. This finding may also suggest that under-represented minorities may not feel a sense of “belonging” in engineering—a factor that has been strongly linked to retention [18].

Our respondents told us that perception fears that inhibited female and minority can be greatly reduced—if not eliminated—by passionate professors who show that they are invested in student learning. When teachers are proactive in encouraging students to attend office hours and show enthusiasm for teaching, student discomfort disappear. These results are consistent with other research that emphasizes the importance of faculty role models and relationships in retention [19].

We also found evidence that male students' pride often prevents them from seeking help. Over one quarter of the men we interviewed described themselves as too proud or independent to seek help from professors or peers. These findings are consistent with research that suggests that engineering students value independent problem-solving, even at the expense of efficiency [1], [10]. It seems necessary to stress to engineering students that while independence is an admirable trait, being able to ask for help, and give help, is also an admirable trait in the field and workforce.

Although many students have developed strategies for overcoming their fears about perceptions, the fear itself takes a psychological toll that puts these students at risk of leaving engineering. Our results suggest several solutions that could improve the climate for women and under-represented minorities. First, professors who explicitly encourage students to ask questions go a long way towards mitigating student fears. We also believe that entering engineering students would benefit from a discussion of what strategies other students have used to successfully

obtain help while minimizing threats to their self-esteem. For instance, many students in this study told us they had learned to work on problems independently and then bring their progress and a list of specific questions to their professors. Engineering students may also need to be persuaded of the benefits of learning to ask for help. In fact, if students could be persuaded that knowing when to ask for help and how to ask competently are valued life-long skills, female and under-represented students may face fewer fears of stigmatization when asking questions.

The findings from this research need to be verified with a larger sample to further assess the extent to which gender, ethnicity, and academic confidence may interfere with students' abilities or proclivities to obtain the help that they need. In particular, more research is needed to understand the role peers play in encouraging or discouraging under-represented minority students from seeking help. More research is also needed to understand how students' successes in obtaining needed help in school settings translates into success in the professional workplace.

## 5. Acknowledgment

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