PATTERNS OF ACADEMIC HELP-SEEKING IN UNDERGRADUATE COMPUTING STUDENTS

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ABSTRACT

Patterns of Academic Help-Seeking in
Undergraduate Computing Students

Augie Doebling

Knowing when and how to seek academic help is crucial to the success of undergraduate computing students. While individual help-seeking resources have been studied, little is understood about the factors influencing students to use or avoid certain resources. Understanding students' patterns of help-seeking can help identify factors contributing to utilization or avoidance of help resources by different groups, an important step toward improving the quality and accessibility of resources. We present a mixed-methods study investigating the help-seeking behavior of undergraduate computing students. We collected survey data ($n = 138$) about students' frequency of using several resources followed by one-on-one student interviews ($n = 15$) to better understand *why* they use those resources. Several notable patterns were found. Women sought help in office hours more frequently than men did and computing majors sought help from their peers more often than non-computing majors. Additionally, interview data revealed a common progression in which students started from easily accessible but low utility resources (online sources and peers) before moving on to less easily accessible, high utility resources (like instructor office hours). Finally, while no differences between racial groups was observed, the lack of diversity in our sample limits these findings.

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Chapter 1

INTRODUCTION

Help-seeking is an important activity in self-regulated learning [66], involving metacognitive awareness that a problem exists and that help is needed to surmount it and the self-regulatory skill to acquire and process help. A number of factors influence students' decisions around their help-seeking behavior—for example, the student's goal [49], the perceived threat to their self-esteem from help resources [46], and their trust in the utility of the resource [75]. How students navigate the array of help resources available to them can play an important role in their learning experience. However, not much is known about computing students' help-seeking behaviors.

Undergraduate students have numerous sources of academic help available to them. This includes sources that are *anchored* to a specific time or place, like office hours with instructors or teaching assistants, and sources that are *detached* from time and place constraints, like course materials and (for computing students in particular), the Q&A forum StackOverflow [106].

Individual sources of help have been studied in the computing education literature. For example, Ren et al. studied the types of the questions students in a CS 2 course asked at teaching assistant (TA) office hours [80]; Vellukunnel et al. studied the kinds of questions students in a CS 2 course asked in the course Piazza forum [100]; Thinnyun et al. studied demographic participation trends in a course Piazza forum [91]; and Dondio et al. studied the integration of StackOverflow posts into programming course materials [30]. Findings from these papers give valuable information while studying help-seeking resources and are discussed further in §2. Though we did not

find much work related to computing students' help-seeking in instructor office hours, two BoFs [1] held at the SIGCSE Technical Symposia in 2019 [87] and 2021 [52] titled *How Can We Make Office Hours Better?* indicate that it is certainly a topic of interest to the computing education community.

Students' identities play an important role in their help-seeking behaviors. Minoritized students can struggle to form an adequate peer network [64], missing out on an important source of help [93, 64]. Students with a lower sense of belonging may also avoid seeking help in order to strengthen or affirm their academic identity [107]. However, women and underrepresented minority students in computing tend to have a lower sense of belonging [67] and may also be affected by competitive behaviors common in computing [38].

1.1 Motivation

My motivation for this work comes from the current state of the computing field. Women of color received just 10% of CS degrees despite constituting 18% of the overall population [60]. Contrary to the trends in the STEM workforce overall, the percentage of computer scientists identifying as female is dropping. In 1984, Women received 37% of the computer science degrees awarded in the United States [29] but has since dropped to 18% in 2020. Additionally, while disability data in computing is not very well understood, [12] in 2017 9.1% of employed computer scientists had a disability, compared with 11% of college graduates [63].

Under-representation in computer science is a crisis [60]. Not only is access to high-paying jobs restricted, but the lack of diversity in such an important modern field results in a serious societal problem. The world of computing changes so quickly that

[1] "Birds of a Feather" sessions—informal discussions among colleagues with similar interests.

it is often very difficult to understand the sociological and cultural impacts of our technical achievements. The fact that our computer scientist field is overwhelmingly homogeneous leaves our society in danger of both acute exclusion as well as long term disenfranchisement of participation in a increasingly digital society [54, 29].

To make meaningful change in this area, large scale cultural change is needed. A host of cultural reasons are cited as being root causes for why prospective students are not representative of society overall [54, 41, 10]. While addressing root causes can bring about more large scale changes, it is outside the scope of this work. Instead, I have focused on studying students under-represented in computer science in order to open avenues for their success in the field. While recruiting more diverse prospective students would certainly increase representation in the field, we can also improve representation by ensuring the students who have decided to enter computer science make it through university to industry.

Prior work shows that an effective way to boost student retention is to provide helpful academic help-resources [78]. There is fortunately a large range of available resources, including online forums, instructor office hours, tutoring centers, and peer assistance. Outside of computer science, we know that students of different demographic groups access different help resources at different rates [13]. However, no research exists specifically looking at computer science students. This has the potential to be different than other fields due to the digital nature of computer science.

What we know holistically about how computing students use the array of resources available to them is largely anecdotal. Little is known about when and why computing students make use of particular resources, and the extent to which these choices are driven by the academic problem at hand, student/instructor dynamics, or both. Understanding patterns of help-seeking—why students seek or avoid help from certain resources, how useful they find them, and the kinds of help they seek—will help

us identify opportunities for feedback about productive help-seeking. Addressing reasons for students' avoidance of certain resources will help create a more supportive environment for those who struggle to utilize certain help resources. This could have implications for improved retention of historically marginalized demographics in computing.

In this paper, we offer a mixed-methods study examining the help-seeking behaviors of undergraduate computing students in a Computer Science and Software Engineering department at California Polytechnic State University, a medium-sized primarily undergraduate institution (PUI). We used a survey followed by a series of one-on-one interviews with students to examine the help-seeking behaviors and preferences of undergraduate computing students (i.e., students taking computing courses, not limited to computing major students).

We address the following research questions.

1.2 Research questions

RQ1. How frequently do students use different help resources? Our first research question aims to identify which resources are used the most frequently and which are rarely used. This data would provide insight for university departments to be able to allocate resources to either boost utilization of less utilized resources or ensure popular resources have the ability to handle all the students seeking to use them. We elicit patterns of help-seeking behaviors based on how frequently students use the resources available to them. We expect that frequency of help-seeking increases from more formal resources to less formal resources, based on work from Karabenick & Knapp [49] and Wirtz et al. [106]. For example, we expect students from less formal resources, such as online resources, more often than they seek help from instructors.

RQ2. How do students' help-seeking preferences relate to their gender, race, and prior experience with computing? Our next research question seeks to determine if different cross sections of students access resources at different rates. If differences in help-seeking behaviors of students across demographics are found, it would enable departments to make changes targeted specifically at boosting the student success of under-represented groups. Based on prior research, we expect both students from underrepresented racial groups and students who are early in the program will seek help from peers less frequently [64], Additionally, we expect to see women being more likely to seek help than men [13, 21]. We expect students of underrepresented racial groups to seek help differently [13, 64, 93] than other students.

RQ3. How does a student's sense of belonging relate to their help-seeking preferences? Sense of belonging has been linked to increased usage of self-regulatory processes, including help-seeking [108]. Similarly to implications for RQ2, if a relationships are observed between sense of belonging and help-seeking behavior, it would enable departments to implement interventions to improve student's sense of belonging, such as setting up social events for students in similar cohorts to foster social connections among peers. We expect that students with a higher sense of belonging are likely to seek help from their peers more often and to seek help more frequently.

RQ4. Why do students use or avoid different resources for help? In addition to quantitative findings from survey data, we interviewed students to understand *why* students make the help-seeking decisions that they do. After observing how students utilize help resources, this question seeks to understand the factors influencing these decisions. For instance, if our prior questions identify a resource as being little used, this question would help identify if that resource is unhelpful, or helpful but just hard to access. This information has the potential to identify when students use different

resources as well as what steps could be taken to improve individual resources. We present factors influencing students' help-seeking behaviors.

Summary of results We found that students preferred to seek help from their peers when possible, but faced barriers in doing so, such as fear of accidental illicit collaboration and a lack of a peer network. Women sought help from their peers and instructor office hours more frequently than men did, and a student's sense of belonging had no relationship with their help-seeking behaviors. While no evidence of a relationship between a student's race and their help-seeking frequency for either individual resources or help-seeking overall was identified, the lack of diversity in our sample limits these findings. We also observed a common escalation of help-seeking from online resources, which have high accessibility but less helpful, to peers, less accessible, but more helpful, and finally to office hours, the least accessible, but most helpful.

Chapter 2

BACKGROUND

2.1 Help-seeking in higher education

Academic help-seeking involves identifying a problem, identifying that help is needed to surmount the problem, deciding whether and from whom to solicit help, and finally obtaining and processing help [47]. The types of help that students seek have been conceptualized as *instrumental* (or adaptive) help-seeking, where one asks for help with the goal of decreasing subsequent need for help, and *executive* (or expedient) help-seeking, where one asks asks for help in order to avoid work [46, 66]. Researchers have emphasized that engaging in help-seeking does not imply a lack of independence on the part of the learner. Rather, it is a self-regulatory strategy that students can employ as part of their learning or problem-solving process [66, 48].

Undergraduate students typically have numerous sources of help available to them [106], including their instructors, peers, course materials, and online sources. Wirtz et al. conducted a study at Purdue University examining the help-seeking behaviors of undergraduate Mechanical Engineering students [106]. They found no correlation between how frequently students used resources and how useful they found them. Additionally, they found that students tended to start with *detached* resources—those that are untethered to a time or place, like online sources, peers, or class forums—before moving on to *anchored resources*—those that are bound to a time and place, like instructor or TA office hours—if detached sources are unable to help surmount a problem. In this work, we focus on students in a different discipline (computing

instead of Mechanical Engineering) at a qualitatively different institution (a PUI with a much lower student-to-faculty ratio than Purdue University[1]).

Researchers have studied how students make use of teaching assistants (TAs). For example, Ren et al. provided a simple form to TAs and students to describe what the student needed help with and the type of help that was needed (instruction, clarification, or verification) during TA hours [80]. They found that most questions in TA office hours for a CS 2 course were related to implementing and testing solutions to programming problems, with questions about program design becoming more common as assignments became more complex.

Others have explored students' use of instructor-managed online Q&A platforms like Piazza to seek academic help. These per-class forums give students a low-pressure environment in which to seek clarification or instruction about a specific course. Results have been mixed about the (perceived or actual) impact on learning from using these platforms [62, 72, 27, 100]. In their analysis of the types of questions asked on Piazza in a CS 2 course, Vellukunnel et al. found that most questions reflected students' reasoning or attempts to construct solutions to software problems [100].

StackOverflow is a free public Q&A forum for programming. It attracts millions of users and hundreds of thousands of questions each month. Researchers have studied its use in education, e.g., by integrating it into course materials [30], or comparing its usage trends to a course-specific Q&A forum like Piazza [91]. Little is known about the kinds of the problems that lead students to StackOverflow and its ilk.

Price et al. studied factors influencing help-seeking from an automated tutor and a human tutor while programming [75]. They note that students' previous help-seeking experiences shaped their expectations for the (human or automated) tutor. Students

[1]Roughly 30:1

reported avoiding help due to the perception of dependence on the tutor. Finally, the convenience of obtaining the tutor's help and how easily it could be interpreted were factors influencing help-seeking. Wrenn and Krishnamurthi studied students' usage of Examplar, an automated oracle that can be used to check one's understanding of an assignment specification [109]. They note that it may have reduced load on course staff, since it could handle relatively common questions about expected program behavior.

Peers are an important source of academic help [68, 53, 93, 66]. School is a social system at work [38] and as such, a student's *social capital* plays an important role in their academic success [64]. In a systematic literature review [64], Mishra notes that studying with peers improves performance [25] and enhances students' sense of belonging and expectations of themselves [92]. This is particularly important for minoritized students, since these students can often miss out on the social capital afforded by a peer network [64], particularly in disciplines like computing that face a diversity crisis. Additionally, students with low sense of belonging [40] are less likely to be comfortable seeking help from their peers [107].

2.2 Help-seeking and student identity

Help-seeking behaviors can also differ based on demographic differences [13, 23, 24, 56]. In a 2020 review, Bornschlegl et al. [13] surveyed existing research identifying demographic variables in academic help-seeking behavior. The majority of studies reviewed found that women were more likely to seek academic help than men, and to have better attitudes toward help-seeking (i.e., they viewed it more as a learning strategy and less as a sign of dependence). A majority of studies did not find a relationship between socioeconomic status and help-seeking, and results were mixed

considering the relationship between cultural background and academic help-seeking. Finally, students with prior help-seeking experience were more likely to seek help again.

While this study did not explicitly investigate race, they did find the majority of studies identified a relationship between cultural background and help-seeking. One repeated finding they observed was Asian students were less likely to seek help compared to other groups.

In their study of Piazza usage in introductory, intermediate, and advanced CS courses [91], Thinnyun et al. found that women were more likely to prefer to stay anonymous than men. They also found that women asked more questions, engaged for more time, and achieved higher "reputation" on their answers, and gave fewer answers than men. This is in contrast to findings related to the programming Q&A forum StackOverflow, where women's engagement tends to be drastically lower than that of men [59, 99].

2.3 Sense of belonging

The subjective feeling of fitting in and being valued as part of a disciplinary community has been conceptualized as a "sense of academic belonging" [40]. It has been shown to positively impact students' academic performance, motivation, and retention in computing [11] and other disciplines [39]. Won et al. report that college students' sense of belonging was related to increased engagement with self-regulatory processes like time management, peer-learning strategies, and decreased procrastination [108]. In a follow-up work, they reported that college students' sense of belonging was positively associated with self-reported instrumental (adaptive) help-seeking [107]. Women and students from minoritized racial groups tend to have lower sense of belonging in computing than men and overrepresented racial groups [67].

Chapter 3

STUDY CONTEXT

We studied undergraduate students enrolled in computing courses at California Polytechnic State University. Our department houses two programs—Computer Science (CS) and Software Engineering (SE) and jointly houses a Computer Engineering (CPE) program along with another department[1]. When we refer to "Computing" majors, we are referring to CS, SE, and CPE majors, though we primarily examined their experiences in CS courses. The participant pool is described in more detail in §4.

Our department has a competitive enrollment policy. Competitive enrollment policies can degrade computing students' sense of belonging, self-efficacy, and perception of the department as welcoming [67]. Students are admitted directly into the CS major, or need to meet grade thresholds to transfer into the major from another department. At the time of this work, changes into the SE major were not permitted.

The data for this study was collected during the winter and spring terms of 2021 (January–May), in the midst of the COVID-19 pandemic. At the time of collection, all instruction and academic work had been remote for over a year. While temporary remote learning does change the context of this work, enough time had passed for academic life to adjust to a new quasi-normal. Therefore, when we mention help-seeking in office hours or in class, we mean office hours or class held synchronously over video conferencing software. When we mention seeking help from instructors or

[1]Computer Engineering was later restructured as an independent department.

TAs "online", we are referring to asynchronous contact over email or posts on Piazza or Discord.

One consequence of this time frame is that second-year student had only experienced one full term of on-campus classes, and first-year students none at all. Therefore a caveat should be placed on findings around synchronous resources such as office hours as they may differ from more typical campus life.

Chapter 4

STUDY DESIGN

We conducted a mixed-methods study to better understand our students' academic help-seeking behaviors—when, how, and why undergraduate computing students availed themselves of the plethora of resources typically available to them. We issued a survey to students in our department (§4.1) to learn how often students used different resources and how useful they found them. This was followed up by a series of qualitative interviews with students (§4.2) to learn the factors that influence their decisions to use or avoid certain help resources.

This study design was approved by our university's Institutional Review Board (IRB).

4.1 Survey

Following prior work done by Wirtz et al. [106], participants answered two questions about the help resources available to them. The following resources were asked about:

- Instructor office hours (IN-OH)
- Instructor in class or lab (IN-CL)
- Instructor through online communication (IN-OC)
- Teaching assistant in class or lab (TA-CL)[1]
- Teaching assistant through online communication (TA-OC)

[1]Teaching assistants do not hold office hours at our institution. Therefore TA office hours are not considered as a resource.

- Peers enrolled in the same class (PEC)
- Other peers (OP)
- Computer science department tutoring center (CSTC)
- Online materials specific to the course (OM-SC)
- Online materials NOT specific to the course (OM-NSC)

The first question asked *How often do you access the following resource?* and participants reported on a five-point Likert scale from *Never* to *Every Day*. We were interested in understanding how often each resource was utilized by the overall student population as well as specific groups of students.

The second asked *How useful do you find the following resource?* and provided a five point Likert-scale response from *Not At All Useful* to *Very Useful*. This question also provided a *N/A* option for participants who did not utilize a resource enough to assess its utility, and those responses were omitted from analyses. The hope is that this question provides better context for resource utilization from the prior question. If a given resource reported high perceived utility but low utilization, we could better differentiate unhelpful resources from helpful resources with high barriers of access.

The full text of the distributed survey can be found in Appendix A.

Won et al. [107] report that a students' sense of belonging might affect their help-seeking strategies. Therefore, in addition to the resource frequency and utility questions, participants were asked to rate their agreement to the statement *I feel like I "belong" in computer science*. Agreement was rated on a five point Likert-scale from *Strongly disagree* to *Strongly agree*.

Participants were recruited by emailing the faculty mailing list in our department and asking them to share the survey with their students. We also contacted computing clubs on campus to request that they forward the survey to their members. Finally, we posted the survey to social media groups and online forums for students at the university taking computing courses.

Table 4.1: Summary of study participant demographics.

	Survey (n=138)	**Interviews (n=15)**
Race		
White	77 (56%)	6
Asian	39 (28%)	6
Two or more*	10 (7%)	—
Latinx/Hispanic*	9 (7%)	2
Filipino*	1 (1%)	1
Black / African American*	0	—
Native American*	0	—
Native Hawaiian or Pacific Islander*	0	—
Prefer not to answer	2 (1%)	—
Gender		
Men	92 (67%)	9
Women	44 (32%)	6
Non-Binary	0	—
Prefer not to answer	1 (1%)	—
Gender * Ethnicity		
White Men	56 (40%)	3
White Women	21 (15%)	3
Asian Women	19 (14%)	3
Asian Men	18 (13%)	3
Underrepresented Men	16 (11%)	3
Underrepresented Women	4 (3%)	0
Major		
Computing	108 (78%)	11
Other	30 (22%)	4

* Analyzed as Underrepresented

We received 138 survey responses. Demographics of survey participants are summarized in Table 4.1. While the demographic breakdown is heavily skewed toward White men, this breakdown is unfortunately consistent with our department's student population. As the sample size was so small for racial groups other than White and Asian, all other groups were analyzed as *Underrepresented* students. Our Similarly, student majors were grouped into *Computing* and *Other* due to the small number of non-computing majors in our sample. Finally, we did not receive non-binary or free-response Gender responses. Due to the lack of statistical power, we omitted the single "Prefer not to answer" response from our analysis.

Our survey design utilized race categories from the U.S. Census Bureau. However, we realized during the course of this work these categories are lacking in a number of areas. For instance, the *Asian* category encompasses a vast number of different people groups. One area of improvement for future work would be to use additional and more specific categories to better capture racial data.

The significance level for all statistical tests is $\alpha = 0.05$.

4.2 Interview

The survey included a final question asking if the participant would be interested in participating in an interview. Of the respondents who replied in the affirmative, 15 participants were invited for interviews. Interview participant demographics are in Table 4.1. Participants were chosen to maintain parity with the makeup of the survey respondents in terms of gender, racial, and major. Each interview took approximately 30-45 minutes and was conducted over video call. Participants were compensated with a $25 Amazon gift card. The interview questions found in Table 4.2 were used as

Table 4.2: Interview discussion questions

#	Interview Question
1	When you encounter difficulties in your CS classes, what is the primary way you get help?
2	What other resources have you sought help from and how helpful were they?
3	What are the best aspects of [help seeking methods that the student mentioned]?
4	What stops you from using the resources you've tried but didn't continue to use?
5	What are the most popular ways you've seen classmates seek help? Are they different from your preferred help-seeking methods?
6	What are some ways you identify that you've reached a point where you need help?
7	How do you decide to go to office hours? Are there certain instructors who you feel more comfortable going to there office hours? Why?
8	What are some ways in which you seek help in your General Education classes?

starting points for unstructured discussions. The full interview script can be found in appendix B

Chapter 5

RQ 1. FREQUENCY OF ACCESSING HELP-RESOURCES

We examined the frequency with which students accessed 10 help resources available to them. Some trends are apparent in Figure 5.1. The most frequently used resources were online materials and peers enrolled in the same course (median *Every Few Days*) and instructors in class or online (median *Once a Week*). Less frequently used were instructor office hours, peers *not* in the same class, and TAs in class (median *Every Few Weeks*). Students rarely made use of TAs online. The departmental peer tutoring center was *Never* used by the vast majority of first- and second-year students (83%)

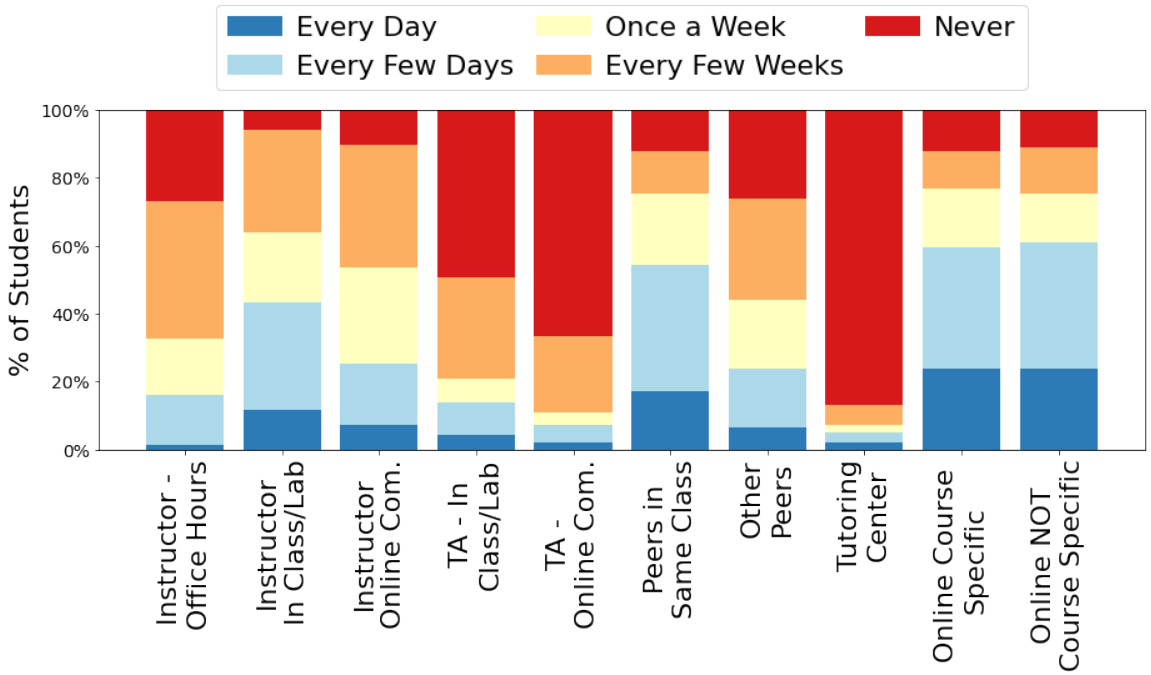

Figure 5.1: Frequency of using help resources

5.1 Exploratory Factor Analysis

Following Wirtz et al. [106], we conducted an exploratory factor analysis (EFA) to elicit patterns of help-seeking behavior from the survey data. The goal of exploratory factor analysis is to uncover underlying relationships among a large set of variables (in this case, the 10 help resources). These underlying relationships are referred to as "factors". "Factor loadings" measure the influence of a factor on a variable. While any variable may be influenced by any factor, EFA focuses on the factor that most strongly influences a variable.

The number of factors was determined using a scree plot. Initially, a three-factor model emerged. This initial factor structure failed to strongly load the departmental tutoring center to any factor (i.e., it had no strongly influencing factors). In light of that and the highly skewed nature of tutoring center usage (Figure 5.1), we omitted the tutoring center from factor analysis.

Table 5.1 contains the resultant factor structure, depicting factor loadings that were higher than 0.4. Three strong factors emerged. Factor 1 resources were those that involved the course instructor (in office hours, in class, or online using email or platforms like Piazza). Factor 2 resources were those that involved the TA (in class or online). Factor 3 resources included peers enrolled in the same course, peers enrolled in other classes, and online sources that were specific to the course.

Online sources that were *not* specific to the course did not fit well into the EFA model, appearing distinct from the other resources. A possible reason for this emerged during interviews (§8.1): students often did not consider using online sources as "help-seeking", but rather viewed it as part of the learning or problem-solving process

Table 5.1: Exploratory factor analysis factor loadings

Help resource	Factor 1	Factor 2	Factor 3
Instr. office hours	0.69		
Instr. in class or lab	0.60		
Instr. online	0.67		
TA in class or lab		0.94	
TA online		0.55	
Peers in the same class			0.67
Other peers			0.47
Online sources specific to the course			0.62
Online sources not specific to the course			
% variance	16.25%	15.59%	15.35%
Cumulative % variances	16.25%	31.84%	47.19%

(unlike other help resources). However, since no obvious issues of skewness in terms of usage frequency or usefulness were observed, we left it in the EFA model.

In our EFA, we observed the resource factor grouping mapped to the level of *formality* of a resource, a concept found in prior work on help resource and usage [49]. Factor 1 resources, involving the instructor, are *formal* help resources. Factor 2 resources, involving the TA, are *semi-formal* resources. Finally, Factor 3 resources—peers and online sources—are *informal*.

For comparison to prior work, we see that Wirtz el al. [106] reported the emergence of *anchored* and *detached* resources[1]. In quantitative analysis, they further break down anchored and detached resources into "tiers", roughly corresponding to the formality of the resources.

Like Wirtz, we observed little relation between the frequency of using a resource and its perceived usefulness. Looking at the perceived usefulness data in Figure 5.2, we can see there is little difference in perceived usefulness among available help resources.

[1]Roughly corresponding to synchronous and asynchronous resources.

All resources were judged to be *Useful* or *Very useful* by the median student. This coupled with the frequency results indicates that while students use certain resources more frequently than others, they consider any method of help to be generally useful.

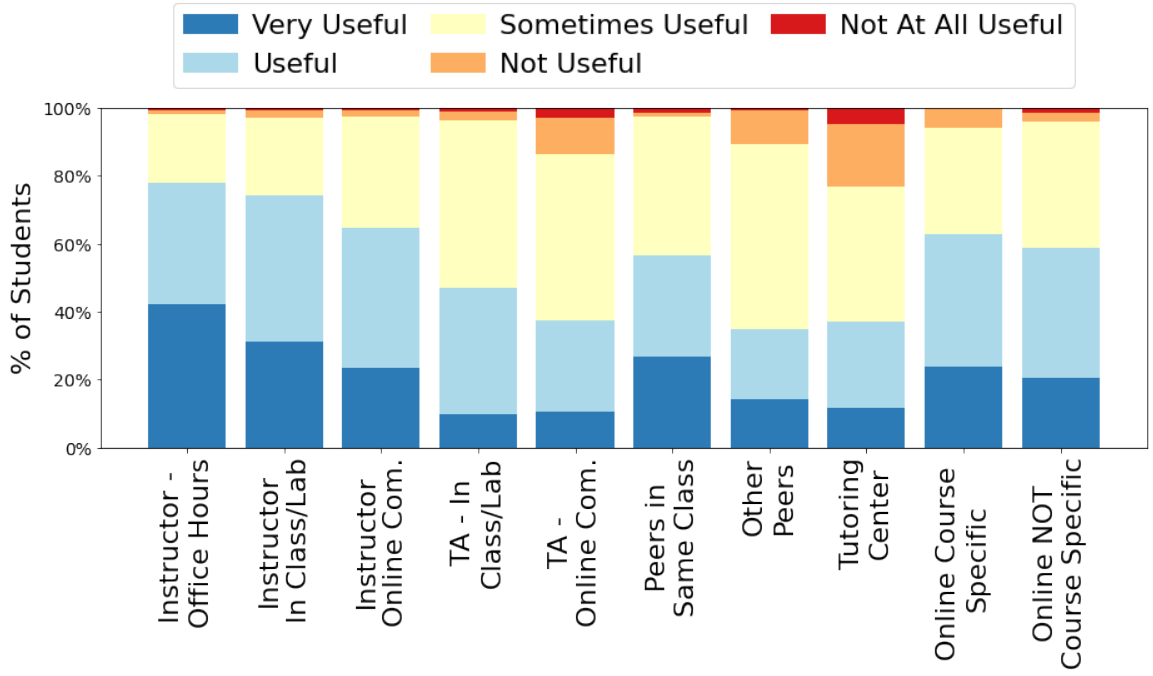

Figure 5.2: Perceived usefulness of help resources (excluding N/A responses)

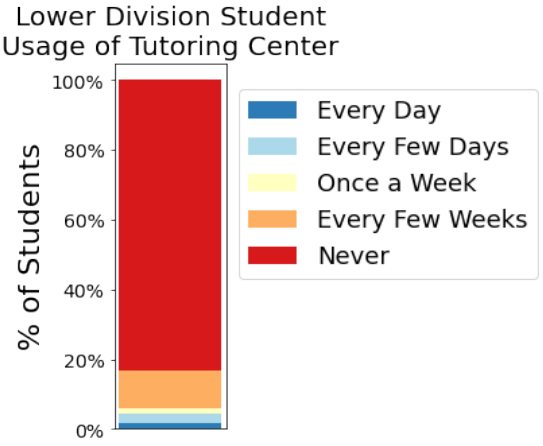

Figure 5.3: Usage of tutoring center among eligible (lower division) students

5.2 Tutoring Center

The least used resource among those considered was the CSSE department tutoring center. Nearly 87% of students reported using the tutoring center *Never*. However, this resource is only available to students in lower division computing courses (until CPE 357). Excluding ineligible students from our analysis shows the usage rate of this resource is still very low. Over 83% of lower division students still reported using the tutoring center *Never*. We theorize that while this resource is one of the least used resources, it is particularly vulnerable to changes due to remote learning, and these results, in particular, should be taken with a grain of salt.

Chapter 6

RQ 2. STUDENT DEMOGRAPHICS AND HELP-SEEKING

We report relationships observed between help-seeking frequency and gender, race, major discipline, and programming experience.

6.1 Gender

Women attended instructor office hours more frequently than men did. After enumerating the Likert scale responses on a scale of 0 for *Never* to 4 for *Every Day*, the median response for women's office hour attendance was *Once a Week* compared to *Every Few Weeks* for men. Welch's unequal variances t-test[1] indicated that this difference was statistically significant ($t = 5.51; p = 0.020$).

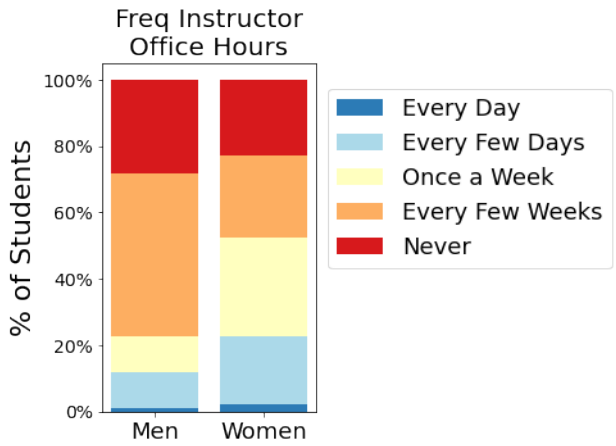

Figure 6.1: Frequency of office hours usage by gender

[1]Since office hours frequency was non-normal (Shapiro-Wilks test; $p < 0.0001$) and heteroscedastic across gender (Levene's test; $p = 0.009$), we opted for non-parametric testing. Similar non-parametric testing is carried out in the rest of this paper.

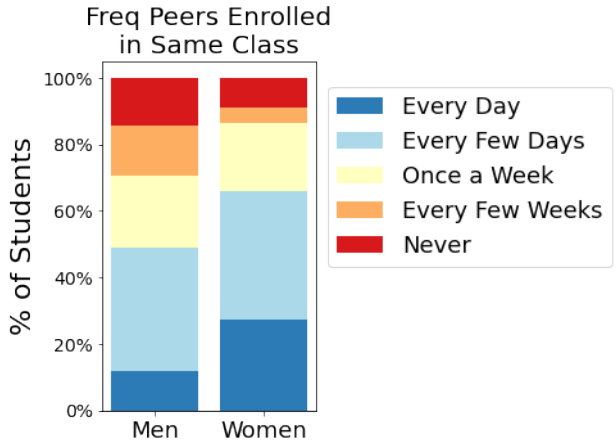

Figure 6.2: Frequency of peer usage by gender

Cohoon [23] suggests that one possible reason for low retention of women in CS departments is the scarcity of women peers from whom to seek academic help. With this in mind, we would expect women to seek help from their peers less often than men do.

However, we found that women sought help from their peers enrolled in the same course as them more frequently (median *Once a Week*) than men did (median *Every Few Weeks*), though men are significantly overrepresented in our department. This difference was statistically significant ($U = 1523, p = 0.016$). We did not analyze the demographics of the peers students received help from in this work. However, anecdotal evidence suggests this may be a fertile area for future work (§10).

There was no difference between men and women's median help-seeking frequency across all resources ($U = 1662.5, p = 0.09$).

6.2 Race

We observed no evidence of a relationship between a student's race and their help-seeking frequency for either individual resources or help-seeking overall. Although we

do recognize this report may be inaccurate due to our low number size of students from under-represented racial groups. Additionally, since our analysis grouped all under-represented races into a single group, differences within this group may exist which we were unable to detect.

6.3 Major discipline

At our university, introductory computer science courses are taken by students majoring in subjects like art, graphic communication, and other engineering disciplines. We examine whether non-computing majors' help-seeking frequencies different from computing majors.

Students in computing majors relied on their in-class peers more frequently (median *Once a Week*) than students in non-computing majors (median *Every Few Weeks*) ($U = 2080.0, p = 0.014$). This is likely because computing majors know more people in computing courses than students in other majors.

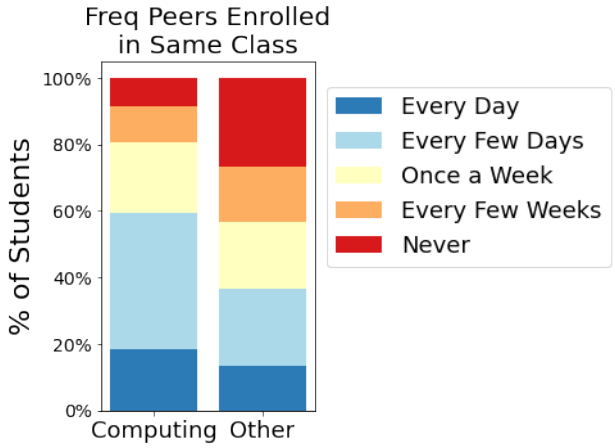

Figure 6.3: Frequency of peer usage by major

Computing majors reported that they sought help from online course materials *Every Week*, more frequently than non-computing majors, who did so *Every Few Weeks*

($U = 2084, p = 0.013$). This may be a function of course content that is available to students in more advanced computing classes, rather than a difference in help-seeking behavior. It could also be that computing majors are more familiar with online sources related to programming than non-computing majors are, since many of our majors have had pre-college experience with computing.

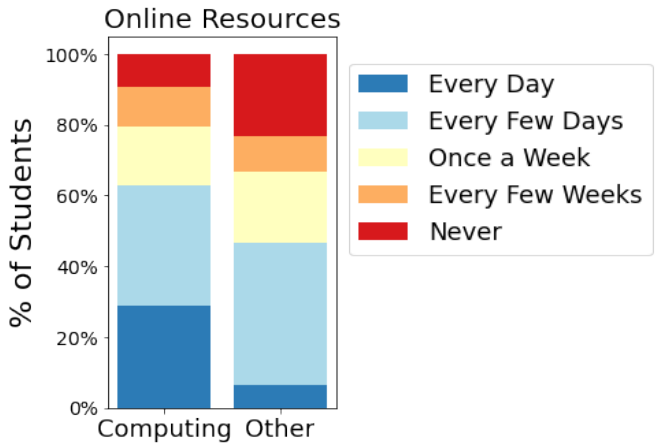

Figure 6.4: Frequency of online sources usage by major

6.4 Academic progress

No evidence of an relationship between frequency of use of any resource and academic progress (also referred to as academic standing or academic year). This held true even while investigating the interaction effect of academic progress and sense of belonging (§7.3).

6.5 Programming experience

There was weak evidence of an association between experience with programming and frequency of accessing TAs in class. A Kruskal-Wallis test indicated that the frequency of seeking help from TAs in class was related to when the student had started

programming ($H = 9.42, p = 0.024$). Posthoc testing with Dunn's test indicated that students who had started programming in the present academic term sought help from their TAs more frequently than students who had started programming in a previous college term, in high school, or before high school. We note that only 7 students in our sample had started programming in the present academic term, so this result may not be of practical importance.

However, it would make sense if reliance on TAs in class plateaued as a student became more experienced with programming. Additionally, the in person help from TAs is likely to get replaced by peers as students progress through the curriculum and have opportunities to form a peer network.

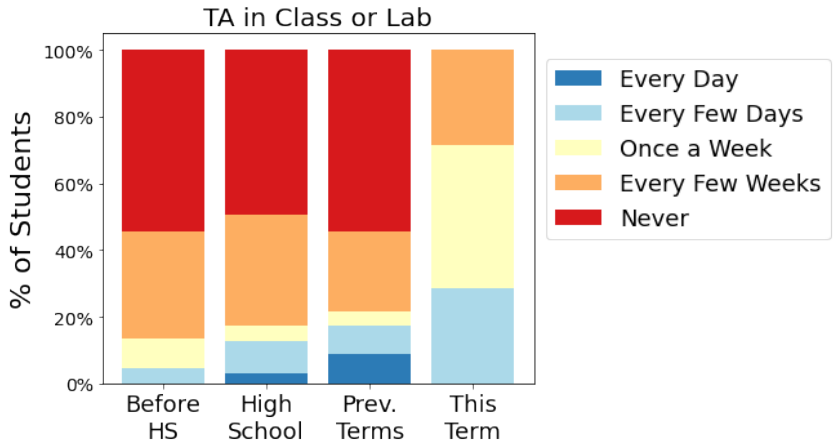

Figure 6.5: Frequency of TA usage by programming experience

6.6 Perceived Utility

Turning to the perceived utility of resources, no significant differences were observed among student demographic variables and their help-seeking preferences, since resources were fairly uniformly rated as *Useful* or *Very useful*.

Chapter 7

RQ 3. SENSE OF BELONGING AND HELP-SEEKING

Sense of belonging [40] has been linked to usage of peer-learning strategies [108] and instrumental help-seeking [107]. We expected that students with higher sense of belonging are more likely to rely on their peers, instructor office hours, and TAs in class.

Participants were asked about their sense of belonging with the the item *I feel like I "belong" in computer science*, with responses ranging across a 5-point scale from *Strongly agree* to *Strongly disagree*. We split the Likert scale data into two groups. Participants who responded *Agree* or *Strongly agree* were considered to have a high sense of belonging (59%). Participants who responded *Neutral*, *Disagree* or *Strongly disagree* were considered to have a low sense of belonging (41%).

Among the sense of belonging responses, we observed a difference across gender lines. While this is interesting to note, it is not the primary focus of this work and other work in our department has covered this topic in more depth [88].

7.1 Sense of Belonging by Demographics

A chi-squared test for differences in frequencies suggested that women were less likely to have a high sense of belonging in computing than men ($\chi^2 = 6.934, p = 0.008$). 68% of men *Agreed* or *Strongly agreed* that they felt like they belong in computer science, compared to only 43% of women.

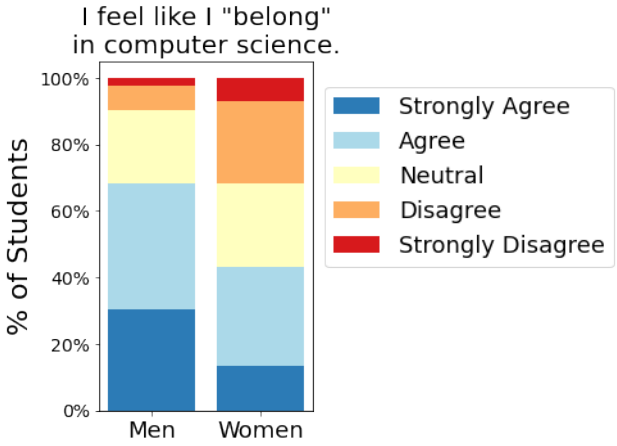

Figure 7.1: Sense of belonging by gender

We found no evidence that students from minoritized racial groups were likely to have a lower of belonging than White or Asian students ($\chi^2 = 5.835, p = 0.054$)). 55% of minoritized students, 46% of Asian students, and 69% of White students *Agreed* or *Strongly agreed* that they belong in computer science. Note that only 20 students out of 138 respondents belonged to minoritized racial groups, greatly reducing our statistical power.

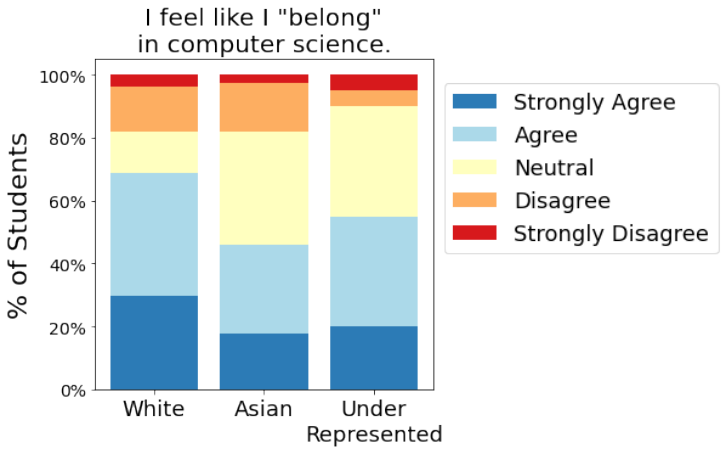

Figure 7.2: Sense of belonging by race

7.2 Resource Usage

In terms of TA usage, students with high sense of belonging sought help from TAs in class or lab significantly less frequently (median *Never*) than students with a low sense of belonging (median *Every Few Weeks*). Welch's unequal variances t-test indicated that this difference was statistically significant ($t = -3.04, p = 0.003$).

Looking at the departmental tutoring center, we found that first- and second-year students with a lower sense of belonging used the tutoring center slightly more frequently than those with a higher sense of belonging. Though this difference was statistically significant ($U = 388, p = 0.002$), it may not be of practical significance: the median student in both groups *Never* used the tutoring center.

We found no evidence of a relationship between sense of belonging and frequency of help sought from peers in the same class ($U = 2330.5, p = 0.88$) or other peers ($U = 1898.5, p = 0.076$). We also did not find evidence to suggest that students with a high sense of belonging tended to seek help more frequently (across all resources) than students with a low sense of belonging ($U = 1942, p = 0.12$).

We found no significant differences in perceived utility of various resources based on students' sense of belonging.

7.3 Interaction with Academic Progress

No evidence for an effect of academic progress was found for either sense of belonging or frequency of use for any help resource. Still we were interested as to whether there was an interaction effect of academic progress and sense of belonging on the usage frequency of any help resource. This deeper investigation would uncover if, for

instance, low belonging 1st year students used a particular resource more than their high belonging peers in the same year. However, no evidence of an effect of either academic progress, sense of belonging, or the interaction of these variables was found for any considered help resource.

Chapter 8

RQ 4. FACTORS INFLUENCING HELP-SEEKING OR AVOIDANCE

Having found correlations between student identities and experience and their help-seeking preferences, we turn to qualitative interviews to investigate causation. We present findings from a series of semi-structured interviews with students. The interview questions are in Table 4.2. Here we describe the emergent factors influencing students' decisions to use or avoid different resources.

To analyze our interview data, we used thematic content analysis [5]. After all 15 interviews were completed and transcribed, we began coding segments of the transcripts. We worked through the transcripts in order of length, starting with the longest, reasoning that we would uncover a richer set of codes from the longest transcripts. The eight longest transcripts were individually coded by both authors. Each code represented a sentiment about help-seeking expressed by the participant. We then collaboratively merged our code books into higher-level codes or themes, which one author then used to code the remaining transcripts.

An emergent theme was that students sought help from progressively formal sources. When one resource failed to help surmount a problem, students would move onto the next-most formal resource. The **online sources → peers → instructor** progression was described by a majority of participants (P1, P3, P4, P7, P8, P9, P11, P12, P13, P15). This progression from informal to formal sources of help echoes findings about Mechanical Engineering students from Wirtz et al. [106], though that work focuses on the synchronous or asynchronous nature of resources instead of their formality.

Although survey responses indicated that all resources were considered useful, the responses presented below revealed another progression of **easily accessible, low utility → not easily accessible, high utility** resources. That is, students would first exhaust resources that are easily accessible but not always the most useful (like peers and online sources), before moving to resources that are less easily accessible but more useful (like instructor office hours).

8.1 Online sources

Nearly all interview participants reported going to online resources as their first form of help. In this context, we mean "online sources" to be online forums like StackOverflow, websites like YouTube, or online course materials. We do not consider office hours (which were held online during the COVID-19 pandemic), email, or Piazza to be "online sources of help"; those are categorized as seeking help from an instructor, TA, or peer, as appropriate. Students implied a low barrier for seeking help through online resources due to the ease of access and minimal preparation required:

> *Just ease of access, it's just completely instant and I can search whatever is on my mind and I don't even have to formulate my thoughts really well.* — P13, 1st year

Many participants did not immediately report online resources in their help-seeking as they considered it integral to their learning or problem-solving process. This may explain why the frequency of using "Online sources not specific to the course" remained distinct from other help resources during exploratory factor analysis (§5)—students did not view it help-seeking, but rather viewed it as helping themselves.

...so I guess [online sources like StackOverflow and YouTube] would probably be my first help seeking, but that's just also like part of the process of coding at this point. — P15, 4th year

The Q&A forum StackOverflow was mentioned by all the students we interviewed. Students reported turning to StackOverflow for very specific technical questions, and less often for higher-level conceptual questions.

[StackOverflow is helpful when one is looking for] a quick solution, especially for if you're new to a programming language or new to an API or something. Quick solutions to see how people do stuff and that can just help you get the ball rolling. — P11, 4th year

Students also reported that a deterrent to using StackOverflow was that it contains large amounts of information that is incorrect or irrelevant to their particular problem. It takes experience and expertise to sort through this information (P5, P9, P11).

I honestly think like it's a really helpful resource as you get older... But I feel like in introductory classes...I'd click on a link and be like "I don't know what half these things are. I think like one-eighth of this page is what's relating to my problem, but I don't know how to like take that out." — P5, 4th year

8.2 Peers

If online sources were unable to provide sufficient help to a student's problem, the most common next step was to seek help from peers. While some students (P5, P14) reported accessing peers even before looking online, most exhausted independent help

resources before reaching out to others. Many benefits from peer help were reported, including ease of access (P5, P10, P11, P12, P14, P15), help being beneficial to both students (P7, P13), and peers providing an informal, stress-free environment in which to seek help (P11, P5).

While peers are not as ubiquitously available as online resources, students can still access help through peers relatively easily.

> *First [I reach out to] friends...like it's literally like a Snapchat or like message away, whereas professors are a little harder to contact when you actually need help. So yeah, I think that's why friends would be number one even if they don't know the answer.* — P14, 2nd year

Many students reached out for help from peers via text message, but students also reported digital student communities on platforms like Discord (P4, P7), increasing the availability of peer help.å

Students reported that peer help was beneficial for both the student asking for help and the student giving help. If both students come to the situation with incomplete knowledge of a topic, they can help fill in each other's knowledge gaps (P7, P13).

> *It's easier and we just end up helping each other. So it's like a win win.* — P13, 1st year

Finally, students reported that peer help was more informal and less stressful than getting help from instructors or tutors (P5, P11).

> *Honestly, I think the biggest benefit for peers for me is it's like the least amount of risk, like it's a lot less scary to ask a peer for help than a professor.* – P5, 4th year

It's kind of a no-judgment zone. If you text your friend they're probably more willing to help you than not and not judge or call out mistakes. — P11, 4th year

The instructor (and often the TA) play a formal evaluative role, unlike peers. The threat of judgment or penalization perceived from a help resource tends to be higher for more formal sources of help [46]. For example, one student (P10, a 2nd-year non-computing major) mentioned that they avoid instructor office hours when they have procrastinated on an assignment, for fear of judgment.

There were also barriers to students being able to access help through peers. First, a solid peer community is needed for a student to be able to access peer help. This can be challenging, especially for students who have not had time to form a peer network—like first-year students or students who transferred into the program from another institution or major—and for students from minoritized groups [64]. During interviews, students reported that a lack of such a peer network made help-seeking difficult (P7, P12):

There's so many gaps in my knowledge that I was kind of like, you know, for a long period of time...I don't know who to ask, what to do, whatever. — P7, 3rd year

When I was a first year I didn't have very many contacts in my major to go for...To go to for help for solving problems. — P12, 4th year

Additionally, many students reported that fear of illicit collaboration hindered their ability to seek help from peers (P3, P7, P9, P12, P13, P14). The policy in our department—like, we expect, in most departments—is that students are not allowed to look at each other's code, in order to prevent plagiarism. Obvious exceptions are collaborative assignments like group projects. While this policy may be effective at

preventing plagiarism, it appears to also be affecting students' ability to give and receive help from each other.

> *I understand that it's necessary as far as academic honesty goes, but from a learning standpoint I think it's kind of a shame.* — P12, 4th year

> *You can talk about the concepts. That's fine throughout like all classes, but once it comes down to the nitty gritty of hey, this how did you exactly do this part? That's where friends are pretty much useless.* — P14, 2nd year

8.3 Instructors

In the progression that we observed, if both online resources and peers were unable to solve the student's problem, help from the instructor would typically be the next step.

While synchronous in-person interaction was a common form of help from the instructor, asynchronous instructor help via platforms such as Piazza or over email was frequently used for smaller questions (such as announcements or assignment clarifications (P4, P5, P12)), and often as a preferred step before attending synchronous office hours (P6, P7, P11, P13, P15). This asynchronous communication can be seen as a sub-step in the **online sources → peers → instructor** progression.

> *I'll email the teacher or post on piazza, and if that's not working, I'll go to in person interaction at their office hours* — P7, 3rd year

Students reported several benefits to seeking help from instructors asynchronously online. First, like the prior steps in this progression, it does not require scheduling or

traveling to campus (P2, P15). Second, on platforms like Piazza or Discord, students find questions that other students have asked to be helpful.

> *...sometimes people might just be in the beginning stages of just understanding [an assignment], whereas some people are just like much faster. And they're already like near the end, so they have more like technical questions. And these questions and answers, once they've been answered by either the TA or the professor, can be really helpful later on when you're actually working through* — P14, 2nd year

Synchronous instructor help, most commonly during office hours but also during lab sessions, was reported by students to be the most useful form of help. One reason reported was that instructors are deeply familiar with projects they assign. They have seen many of the common bugs, pitfalls, and strategies used for the assignments, and are thus suited to give useful help (P3, P5, P8, P9, P12, P14). Students also reported that synchronous office hours helped them form connections with their instructors (P8, P11, P14, P15), which made help-seeking a stress-free experience.

A few factors emerged that influenced students to avoid instructor office hours. Students reported avoiding office hours as they are often crowded, and many expressed discomfort asking for help in front of other students (P5, P10). Some students also felt that many instructors have an "expert blind spot" or *tacit knowledge* (P3, P5, P7, P11). This makes it difficult for them to give help at a level suitable for the student, and makes it difficult for the student to understand how the help given translates to their problem.

> *Sometimes professors are just so far advanced that they don't really understand why a student would not understand something* — P5, 4th year

A lot of professors really know what's going on, but they might struggle to convey that information and they can confuse you more. That's also a big factor of whether or not you go to office hours. — P11, 4th year

Importantly, students reported that some instructors can be intimidating or demeaning in class or office hours, making it a stressful experience to seek help from them or professors in the future (P3, P5, P9, P10, P11, P15).

Previous experiences at office hours haven't been the best...I haven't really gone into office hours since...When I asked them a question they kind of like assumed I should already know that and they asked me if I really wanted to be programmer — P15, 4th year

[in comparison to peers,] some professors [or TAs] are not great at calling out mistakes in like a constructive manner...they might say it in a more demeaning way. — P11, 4th year

The professor's reputation for being approachable played a role in students' decisions for whether or not to attend office hours (P1, P3, P8, P9, P11, P14, P15). While students eventually formed opinions about approachability for themselves, they often relied on the opinions of friends who had previously taken the instructor as the first measure of approachability.

Finally, procrastination appeared to factor into students' decisions to attend office hours. Students waiting until closer to a deadline to start assignments often lost the ability to access more synchronous resources such as office hours due to availability (P7, P10). One student reported avoiding office hours when they were working close to an assignment deadline for fear that the instructor would judge them (P10). On

the other hand, one participant indicated that they *prefer* office hours when they are coming up on a deadline, since instructors can identify issues quickly due to their experience with the assignments (P13). This may be an example or expedient help-seeking [46].

8.4 Teaching assistants and peer tutoring

Overall, participants did not talk about TAs often. Help sought from TAs appeared to be opportunistic or by happenstance, e.g., if they were available during a lab session, or if they happened to respond to a post on Piazza or Discord.

It should be noted these findings may differ if repeated at a different institution. Unlike many other universities, the majority of TAs are undergraduates, with no PhD students, and class sizes are typically limited to approximately 30 students, allowing relatively high instructor access.

Participants felt experienced TAs were more helpful. This is in contrast to Patitsas et al. [73], who found no difference between student evaluations given to experienced and inexperienced TA, though they note that student evaluations are often not the best measures of TA quality. Inexperienced TAs were reported as hesitant to give specific help, giving "vague" advice rather than actionable direction (P10).

Among the available resources, the computing department tutoring center was the least utilized (Figure 5.1). A common reason cited for this was that students took a couple of terms to find out about the tutoring center, often from their peers (P14, P11). A large portion of the students had not heard of the resource. Paradoxically, some participants who *had* used the tutoring center reported that it had been crowded as tutors hurried to help all the students who attended (P1, P7, P5, P11, P12). The

tutoring center was reported to be a good confidence-builder during early courses (P11).

8.5 General help-seeking

A few factors emerged as being influential for the decision for whether or not to seek help (from any resource).

Computing students can be prone to comparing themselves to peers and taking actions to affirm their sense of belonging in computing [38]. One such action might be help-avoidance in order to affirm one's identity as a computer scientist or programmer. Students reported that in early years they had a sense that they needed to surmount their problems on their own. They felt that seeking help too soon, or at all, prevented them from learning the material appropriately (P5, P13). One student characterized going to instructor office hours as "giving up".

Additionally, discomfort asking for help in front of other students was a common factor influencing help-seeking from group-oriented resources like the tutoring center, office hours, or Piazza (P5, P10).

> *...every time I hop into professors office hours for the first time I always have a little bit of panic of like—how are they going to do it? 'Cause some some professors do office hours where they like take one person into the room at a time while other professors do like large groups* — P5, 4th year

Students also reported that weekly lab sessions in which they worked on assignments in class increased their likelihood of seeking "in-person" help from their TAs or instructors (P5, P9, P10, P11).

Chapter 9

DISCUSSION

Here we discuss some implications of our findings. First, while peer help was one of the most preferred forms of help-seeking, it was often stifled by rules against collaboration. Sukhodolsky suggests that academic dishonesty might be a worse problem in computer science than in other disciplines [89]. Whether or not this is empirically true, it would be unfortunate if a consequence of combating it is that students are wary of working together—as we have seen in §8.2, students find their peers to be useful sources of help for a number of reasons. Generalizing beyond our study, research has found that working with peers can improve performance [64] and enhance a student's sense of academic belonging [92]. Indeed, children begin to favor peers over "experts" as sources of help from an early age [66]. Additionally, the lack of access to a consistent peer network (§8.2) was a barrier to peer help. Both issues could be mitigated by featuring group work more prominently, especially in early courses. Not only does this provide students access to peers to work with "legally", it can also lay the groundwork for a peer network that lasts throughout one's academic career.

Furthermore, we observed online resources such as StackOverflow can be challenging for novices (§8.1). For those unfamiliar with the content as well as navigating these sites, it can be difficult to sort through the large amount of information, only some of which is relevant. To mitigate this, instructors in introductory courses could demonstrate navigating online resources and parsing the available information, e.g., while teaching by live-coding [85]. Introducing sites such as StackOverflow in this way would display the utility of these resources while showing how to avoid getting bogged down by unhelpful information.

Students reported that negative experiences in office hours lead them to avoid office hours *in general*, not just those of the instructor in question (§8.3). Additionally, because peer opinions of an instructor were an important factor in whether a student first attended an instructor's office hours, poor experiences in office hours can have a cascading effect. With this in mind, computing instructors and administrators should take steps to ensure that office hours provide a safe environment for students seeking help.

Additionally, student reports about the tutoring center (§8.4) revealed the primary reason this resource had lower utilization rates than other resources was lack of awareness. While this is a small-capacity resource, departments should be intentional about increasing awareness of all help resources to promote student success.

While no differences were found between students with regards to race, we feel our limited sample size for underrepresented students prevents attributing significance to this. Appropriate analysis of difference in help-seeking behaviors between racial groups would require a much more representative sample in addition to more conscientious selection of considered racial categories.

Contrary to our expectations, we found that women sought help from peers more frequently than men did (§6). A possible explanation for this is the existence of a club in our department for women in computing, housing a robust mentorship program.[1] It is worth exploring how a club like this would influence academic help-seeking through peer networks.

Finally, research suggests that positive experiences in early computing courses reduces attrition [10, 55], and positive instructor interactions play an important role in the learning experience. Considering that women accessed office hours more frequently

[1]Women Involved in Software and Hardware (WISH) https://wishcalpoly.com/

than men (§5), making office hours more welcoming could also have implications for improved retention of women in computing.

Chapter 10

FUTURE WORK

Future studies ought to test the generalizability of our findings. Class sizes at our university rarely exceed 35 students; reliance on TAs or instructors may be substantially different with larger class sizes.

Additionally, the data collection phase of this work was done in the spring of 2021, during the COVID-19 pandemic. As a result of this, all classes and office hours were conducted remotely, as they had been for over a year. This without question affected how students sought help and therefore remains our largest threat to generalizability.

Furthermore, while we attempted to survey and interview as diverse of a student sample as possible, the university and department demographics are themselves regrettably homogeneous. A similar study in a different context would allow for a better understanding of how specific minoritized and intersectional groups of students go about seeking academic help. While this work has focused on slicing groups of students by a single dimension, (race, gender, etc.) it would be beneficial to study the reverberations of student's full intersectional identities.

Continuing on this, if we were to repeat this study, an improvement we would make would be to change our listed racial categories. First, this would address the limited racial categories included in the Census Bureau racial categories [98]. Additionally, this would allow us to break down the diverse people groups lumped into the broad category of *Asian*. For example, the experiences of Indian students may be different from those of Filipino students. Expanding our racial categories would allow future work to tease out these differences.

10.1 Additional Variables to Consider

One variable to potentially include in future work is perception of the department culture and climate, specifically whether the student's sense of competitiveness in the department. Prior work has shown defensive or competitive environments in computer science can hinder development of collaboration [6]. Since we've seen that the ability to form peer networks is an important factor for being able to seek help, it may be that students who perceive the department as more competitive may seek help differently or less frequently.

Another variable to consider is whether the student's native language is the language the course is being taught in. This may make the student feel like an outsider, impacting their sense of belonging. Additionally, even a small language barrier may discourage students seeking help from face to face resources such as peers or instructors. This could also be expanded to the more overarching concept of acculturation, which has been previously been seen to have a relationship with help-seeking behavior [13].

10.2 Related Projects

Continuing our research through future projects have been started to investigate the help-seeking of computing students who have transferred from other universities. While we did not collect survey or formal interview data about transfer students, anecdotal evidence suggests they have a difficult time forming peer networks in the same way as other students. As have seen, the lack of a solid peer network can inhibit the ability to receive help when it is needed. Better understanding of this effect could lead to valuable insights about promoting transfer student success.

Further topics to study along this path of research could include a longitudinal study of how student's help-seeking behavior changes over the course of their collegiate career. This study could be implemented by first studying the help-seeking of a cohort of freshman students and then following up with the same study yearly, future researchers could better understand how help-seeking behavior evolves.

Additionally, a follow up study could be done to explore usage of instructor office hours across different styles of office hours. Investigating the difference in usage and perceived utility between "open" office hours compared to one-on-one, or appointment-only office hours, could give instructors insight into how best to serve students.

Furthermore, it may be that women in computing report being careful to not ask for help from the same peer too much. This care to maintain an *economic exchange* of help between peers is another area for potential future work. Investigating the perception of economic exchange of peer help and its relation to both gender as well as sense of belonging has the potential to deepen understanding of peer help.

Continuing research into resources specifically in our department, the tutoring center presents a rich area for further work. While we saw overall very low utilization of this resource in this work, this may have been impacted by the pandemic. Additional data from tutoring center usage could answer questions both about the students accessing this resource and the students providing the tutoring. In particular, it would be interesting to see if a relationship is observed with sense of belonging.

Finally, future work should address *teaching* effective help-seeking. Despite its prominence in the learning process—particularly in a project-rich discipline like computing—students are often left to discover productive help-seeking practices for themselves.

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APPENDICES

Appendix A

SURVEY

Help Seeking Behavior Study Survey

Help seeking survey for graduate research. Individual responses from this survey will not be published, but only used to create aggregate statistics.

Thank you for filling out this survey, please reach out with any questions or comments.

Augie Doebling
wdoeblin@calpoly.edu (mailto:wdoeblin@calpoly.edu)

* Required

1. INFORMED CONSENT TO PARTICIPATE IN A RESEARCH PROJECT:
"Computing Students' Academic Help Seeking Behaviors Across Demographics"

INTRODUCTION

This form asks for your agreement to participate in a research project on help-seeking behavior among students taking classes in the Computer Science and Software Engineering Department. Your participation involves taking part in a survey and allowing the use of your answers in research and analysis. It is expected that your participation will take approximately 5-10 minutes. There are some minimal risks anticipated with your participation. You may personally benefit from this study and others may benefit from your participation. If you are interested in participating, please review the following information.

PURPOSE OF THE STUDY AND PROPOSED BENEFITS

• The purpose of the study is to better understand how students of different identities seek help in computer science classes in order to provide the most helpful resources to students of identities underrepresented in computing.
• Potential benefits associated with the study include the ability of computer science departments to provide focused help-seeking resources to students belonging to identities underrepresented in computing

YOUR PARTICIPATION

• If you agree to participate, you will be asked to take part in a survey that will assess your current help-seeking behavior in computer science classes.
• Your participation will take approximately 5-10 minutes

DATA RETENTION

• Individual responses from this survey will not be published, but instead used to create aggregate statistics of responses.
• Once data collection is complete, it will be stored offline on the researcher's computers. Data will only be shared with co-researchers for the purpose of this study.
• All data will be deleted on or before April, 2022

PROTECTIONS AND POTENTIAL RISKS

• Please be aware that you are not required to participate in this research, refusal to participate will not involve any penalty or loss of benefits to which you are otherwise entitled, and you may discontinue your participation at any time. You may omit responses to any questions you choose not to answer.
• There is a minimal risk to your reputation or status should your data be disclosed along with your identity. There also is a minimal possibility of emotional distress should any of the questions trigger unpleasant thoughts or feelings.
• The survey includes a single identifying question, your university email address. This information will only be used to link data from other sources such as a follow up interview. Your email will not be used to contact you, or be transferred, given, or sold to any third party.

RESOURCES AND CONTACT INFORMATION

• If you should experience any negative outcomes from this research, please be aware that you may contact campus Psychological Services at 805.756.2511, for assistance.
• This research is being conducted by Ayaan Kazerouni, PhD. Assistant Professor, and Augie Doebling, graduate student in the Computer Science department. If you have questions regarding this study or would like to be informed of the results when the study is completed, please contact the researcher(s) at ayaank@calpoly.edu (mailto:ayaank@calpoly.edu) or wdoeblin@calpoly.edu (mailto:wdoeblin@calpoly.edu).
• If you have concerns regarding the manner in which the study is conducted, you may contact Dr. Michael Black, Chair of the Cal Poly Institutional Review Board, at (805) 756-2894, mblack@calpoly.edu (mailto:mblack@calpoly.edu), or Ms. Trish Brock, Director of research Compliance, at (805) 756-1450 or pbrock@calpoly.edu (mailto:pbrock@calpoly.edu).

AGREEMENT TO PARTICIPATE

If you agree to voluntarily participate in this research project as described, please indicate your agreement by completing the attached survey. By completing this survey you additionally certify that you are age 18 or older. Please retain a copy of this form for your reference, and thank you for your participation in this research. *

◯ I Agree to Participate in this Research and Am Over the Age of 18

2. What CS Courses are You Currently Enrolled In?

3. Gender

- ◯ Male
- ◯ Female
- ◯ Non-Binary
- ◯ Prefer Not to Answer
- ◯ [ ] Other

4. Ethnicity

- ◯ Caucasian
- ◯ Black / African American
- ◯ Latinx / Hispanic
- ◯ Asian
- ◯ Native American
- ◯ Native Hawaiian or Pacific Islander
- ◯ Two or more
- ◯ Prefer Not to Answer
- ◯ [ ] Other

5. Major

- ◯ Computer Science
- ◯ Software Engineering
- ◯ Computer Engineering
- ◯ [ ] Other

6. Academic Progress

- ◯ 1st Year
- ◯ 2nd Year
- ◯ 3rd Year
- ◯ 4th Year
- ◯ 5th Year
- ◯ Graduate

7. When Did you Start Programming?

- ◯ Before High School
- ◯ High School
- ◯ College Classes in Previous Terms
- ◯ This College Term

8. How Often do You Access the Following Help Resources?

	Never	Every Few Weeks	Once a Week	Every Few Days	Every Day
Instructor - Office Hours	◯	◯	◯	◯	◯
Instructor - In Class or Lab	◯	◯	◯	◯	◯
Instructor - Online Communication	◯	◯	◯	◯	◯
TA - In Class or Lab	◯	◯	◯	◯	◯
TA - Online Communication	◯	◯	◯	◯	◯
Peers Enrolled in Same Class	◯	◯	◯	◯	◯
Other Peers	◯	◯	◯	◯	◯
CSSE Tutoring Center	◯	◯	◯	◯	◯
Online Materials Specific to Course	◯	◯	◯	◯	◯
Online Materials NOT Specific to Course	◯	◯	◯	◯	◯

9. How Useful do You Find the Following Help Resources?

	N/A	Not At All Useful	Not Useful	Sometimes Useful	Useful	Very Useful
Instructor - Office Hours	◯	◯	◯	◯	◯	◯
Instructor - In Class or Lab	◯	◯	◯	◯	◯	◯
Instructor - Online Communication	◯	◯	◯	◯	◯	◯
TA - In Class or Lab	◯	◯	◯	◯	◯	◯
TA - Online Communication	◯	◯	◯	◯	◯	◯
Peers Enrolled in Same Class	◯	◯	◯	◯	◯	◯
Other Peers	◯	◯	◯	◯	◯	◯
CSSE Tutoring Center	◯	◯	◯	◯	◯	◯
Online Materials Specific to Course	◯	◯	◯	◯	◯	◯
Online Materials NOT Specific to Course	◯	◯	◯	◯	◯	◯

10. Do You Agree with the Following Statements?

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I feel like I "belong" in computer science.	◯	◯	◯	◯	◯
I think there is a stereotype of computer scientists.	◯	◯	◯	◯	◯
I fit the stereotypes of computer scientists.	◯	◯	◯	◯	◯

11. Would be willing to be contacted in regards to an additional in-depth interview about help-seeking behavior?

    Interview participants will be compensated in the form of a $25 Amazon gift card. Interviews will take approximately 30-45 minutes

    ◯ Yes

    ◯ No

12. Cal Poly email address for contact regarding the help-seeking interview

Appendix B

INTERVIEW SCRIPT

Augie Doebling
wdoeblin@calpoly.edu
Interview Questions : Help Seeking Behavior

Green Indicates Interviewer Notes

Introduction: The purpose of this study is to identify and analyze help-seeking behavior of students in undergraduate computer science courses and identify differences in usage and perceived value of resources among demographic groups. At any time during this interview you have the right to end your participation or skip questions.

1. When you encounter difficulty in your CS classes, what is the primary way you get help?

   For instance:
   - Google / Stack Overflow
   - YouTube
   - Textbooks
   - CS Tutoring Center
   - Office Hours
   - TA / Lab Help
   - Other Students / Friends

   What do you do first? What's the **best** *way you get help?*

2. What other ways have you sought help through and how helpful were they?

   If needed, go through examples list

3. What are the best aspects of your primary help seeking method?

   Main question, if needed prompt for the following:
   - Is it easy to access
   - Is it welcoming
   - Does it consistently have the answer to your problem
   - Does it give small hints or larger help

4. What stops you from using the resources you've tried but didn't continue to use?

   If needed, reference the factors from previous question

5. What are the most popular ways you've seen classmates seek help? Are they different from your preferred help seeking methods? Why or why not?

Do they see their help-seeking behavior as typical? Do they follow other student's lead on help seeking resources?

6. What are some ways you identify that you've reached a point where you need help? And can you give some examples of situations when you sough help in the course of your work?

   Get concrete examples from at least primary and secondary help resources. Anchor the discussion to their currently enrolled courses if required.

7. How do you decide to go to office hours? Are there certain instructors who you feel more comfortable going to their office hours? Why?

   How do you decide to go to office hours? Are there certain instructors who you feel more comfortable going to their office hours? Why do you think that is? Previous studies have shown, do you feel that way?

8. Do you get help in your GE and support courses in the same ways as your CS classes?

   Does it differ for "technical" vs non-technical classes?

Conclusion: Thank you for participating in this study. As a reminder at any time you can contact me at wdoeblin@calpoly.edu with questions about the study or to request a copy of your identifiable data.