Factors Influencing the Social Help-seeking Behavior of Introductory Programming Students in a Competitive University Environment

ANAEL KUPERWAJS COHEN, Macalester College, USA
ALANNAH OLESON and AMY J. KO, University of Washington, USA

Collaboration is an important aspect of computing. In a classroom setting, working with others can increase a student's motivation to attempt more challenges, reduce the difficulty of complicated concepts, and bring about greater overall success. Despite extensive research in other domains, there has been minimal exploration within computing on what impacts a student's decision to seek social assistance in highly competitive university environments. To understand what affects introductory programming students' social help-seeking behavior in this context, we conducted 32 semi-structured interviews with students and performed thematic analysis and qualitative coding on the ensuing transcripts. Our qualitative analysis revealed 18 significant factors. We noticed that the decision to seek social help involved a two-fold process: first, the decision to engage in social help-seeking, and subsequently, the decision of who to ask for help. Furthermore, we found that help-seeking in computing is not fundamentally different from other disciplines, although some of the factors were unique to the topic of computing and the specific environment of this study. Factors related to communication style, the type of question being asked, and the school's cheating policy were central when discussing code, an integral part of computing. Regarding the environment, students repeatedly reported that the competitive major, the explicit and implicit class standards, and feelings of intimidation, among others, influenced them. These findings suggest that understanding both steps and the sociocultural context is important in order to effectively lower the barriers to asking for help.

CCS Concepts: • **Applied computing** → **Collaborative learning**; • **Social and professional topics** → **Computing education**;

Additional Key Words and Phrases: Computer science education, social help-seeking, introductory programming

ACM Reference Format:
Anael Kuperwajs Cohen, Alannah Oleson, and Amy J. Ko. 2024. Factors Influencing the Social Help-seeking Behavior of Introductory Programming Students in a Competitive University Environment. *ACM Trans. Comput. Educ.* 24, 1, Article 11 (February 2024), 27 pages. https://doi.org/10.1145/3639059

1 INTRODUCTION

Computing is frequently a collaborative process [2, 21, 28, 38]. Not only is collaboration common, but it is also useful in many different situations where computation is involved. Structures are sometimes implemented in both educational institutions and industry to encourage teamwork. For instance, professional developers are grouped into teams that complete projects together, and paired programming assignments are given to students throughout their degree-seeking years. Evidence shows that the most common source of information for software development teams is other coworkers [21]. Pair debugging has also shown an improvement in the rates of both finding and fixing bugs [28, 46].

In a classroom setting, the increased discussion from working in pairs on an assignment can reduce the difficulty of a task, encourage students to attempt more problems, create space for critiques, and lead to higher overall success [17, 28]. Furthermore, students who implement self-regulated learning strategies, such as asking others for help, or social help-seeking, are more successful in their endeavors and in mastering new concepts [2, 19, 34, 47]. Overall, collaborative learning can lead to social, psychological, and academic benefits, such as building diversity and community, increasing student self-esteem, and promoting critical thinking skills [23].

Despite the array of opportunities for and benefits of social learning, some prior work shows that computing students often avoid social help-seeking [9]. Past work in general education or psychology research suggests that a large host of factors can influence a student's social help-seeking behavior. Researchers in these fields have shown that many variables can play a role in what a student does when they get confused while studying, including the decision to seek social assistance or not. Examples of these factors are demographic variables, such as gender, age, and socioeconomic status, and achievement-related motivation, such as self-efficacy, interest, and goal orientation [24].

These factors almost certainly influence the behavior of students in introductory programming settings; however, it is unclear how these factors interact with the specific challenges and culture of **computer science (CS)** education. Prior work on help-seeking in CS education has focused on identifying common or successful self-regulated learning strategies [9, 20, 25–27, 36], investigating the differences between traditional help-seeking behavior and those performed in online settings [7, 14, 15, 36], or specifically examining help in intelligent tutoring systems [37, 44]. These studies often report social interaction, but without further exploration of why social help-seeking was used by students. This work has yet to provide a deep understanding of the reasons students seek or avoid social assistance while studying CS in non-experimental settings.

In this study, we address this gap, exploring the research question, *what factors influence the social help-seeking behavior of introductory programming students in a highly competitive university environment?* The selected institution in this study is a large public university with competitive admissions to the school itself and to many majors, including CS. Students at this university are not guaranteed to study their intended subject, leading to a competitive culture surrounding CS. Since social help-seeking is inherently collaborative, the relationship students have with social help-seeking in a highly competitive environment could surface a diverse array of influential factors. We approached this question by conducting semi-structured interviews with recent introductory programming students (n = 32) and performing thematic analysis and qualitative coding on the ensuing transcripts.

2 RELATED WORK

In education and psychology research broadly, there has been extensive work on the topic of help-seeking in learning. The literature spans a large variety of approaches, such as modeling

how students seek help [29], how students perceive and evaluate help sources [16], and whether students are aware of their own limitations [1]. This work investigates all ages, from elementary school children [3] to college students [11] and graduate students [22], and across identities, regarding socioeconomic status [5], race and gender [43], and so on.

2.1 Adaptive Help-seeking

One key component that has surfaced is the importance of adaptive help-seeking, which focuses on the role of self-regulated learning as a method for focusing on one's individual needs [29–31]. A student's ability to adapt to any situation in order to learn the material independently, as opposed to just focusing on obtaining a solution for the task at hand, is becoming more relevant as classrooms are changing and more is expected from students [33]. The literature makes it clear that effective help-seeking is directly connected to mastery of new concepts [19, 30, 34, 47].

Adaptive help-seeking is inextricably linked to the presence of social interaction. Nelson-Le-Gall originally created a model for the process of help-seeking in younger children [29]. Newman expanded the model to account for a self-assessment that compared the student's confidence on a problem and their tolerance for being challenged [31]. He then altered that model to focus on the use of social assistance, where learners take a certain number of steps: understand the difficulty of the task, determine their need for help, prepare their question, determine who can help them, and use the information they receive from the target source [32]. He concluded that help-seeking is naturally a "social-interactional process" [32] that is influenced by a variety of factors.

2.2 Social Help-seeking Broadly

Due to how critical and present social help-seeking is in learning, recent work in these domains has focused on the factors that influence the decision to seek or avoid social assistance and has found a wide scope of reasons that students take into consideration [4–6, 8, 19, 40–43, 45]. To begin with, there are practical limitations. Often students view sources of help as inconvenient or inaccessible. This could be due to the social norms or constraints of the classroom or the context they are in [42], concerns about the benefit of a specific source [41], or the perceived competence of the help-giver [45]. Students also have concerns about how others, namely the help-giver or their peers, perceive their competence as the help-seeker [4]. They are worried about negative reactions from the help-giver when placing themselves in a vulnerable position to ask for help [45]. In addition, when students are more focused on their status and social visibility, asking for help can be an added burden [41, 42]. Even the act of asking for help can cause feelings of incompetence, especially for students who initially have lower self-esteem [19]. For these reasons, a secure relationship allows students to focus more on the task at hand when asking for help [8, 40].

Some prior work discusses the source of motivation: whether the student is focused on completing the problem, performance-goal orientation, or wants to learn the content deeply, mastery-goal orientation [41, 42]. Learners are more motivated to seek help when focusing on deep understanding. On the other hand, a desire for autonomy [42] or independence [45] leads many students to avoid seeking help, due to standards about completing work independently or the belief that mastery is only possible when working alone. Lastly, an individual's identity can impact their likelihood of seeking social support. One study distributed surveys to middle school students to measure help avoidance [43]. The results backed up similar findings about gender and race, that boys tend to avoid help more than girls and Black students avoid help more than White students. Socioeconomic status can also indicate a tendency to avoid help-seeking, where working-class students are more likely to avoid asking for help than middle-class students [5]. Even family life and parental influence can affect a child's behavior in school and their problem-solving strategies [6].

2.3   Social Help-seeking in CS

Whereas there is an abundance of information about social help-seeking in general, there is little prior work on social help-seeking in CS. The majority of prior work in this area falls into one of three categories: identifying strategies that CS students use [9, 20, 25–27, 36], investigating help-seeking tendencies in online settings [7, 14, 15, 36], or understanding how students engage with intelligent tutoring systems [37, 44]. A variety of methodologies have been used to identify the tools that computing students use, either successfully [26] or unsuccessfully [25]. By analyzing class reflections [9, 20], by conducting interviews [20, 26, 27], and through observation [27], researchers have identified a plethora of strategies, such as internet searches, drawing diagrams, or breaking down the problem and making a plan. Studies often mention the format of social assistance but do not investigate *why* students chose those sources. For example, Knox's body of work focused on the relationship between physical space and learning CS, with one study looking at the practices that students engage in when studying CS in spaces outside of the formal classroom. Reaching out to other members in the community, regardless of being co-located or remote-located, was discovered as a major part of how students study computing. Moreover, Knox observed specific strategies within the broader category of social communication, such as asking a friend or expert [20]. However, a different study reported that social help-seeking was an infrequently used strategy among computing students, despite its importance [9].

The rise of technology, along with the increase in computing courses, has given way to alternate approaches for seeking guidance and tutoring. The use of online help-seeking and intelligent tutoring systems has become more abundant in recent years. Furthermore, collaborative learning is no longer limited to in-person interactions, changing the scope of social learning. Despite that, Hao et al. found that students searched online for help more frequently than asking peers online, and higher-performing students asked for help online more than lower-performing students [14]. Two other studies looked at questions asked in online settings and found that the content of the online inquiries was more likely to be about a specific assignment or coding task [7, 36]. Finally, when studying the predictors of online help-seeking, problem difficulty was found to be the most significant out of eight possibilities [15].

Intelligent tutoring systems have provided a unique opportunity to directly observe the problem-solving and help-seeking processes of computing students. Vaessen et al. conducted a study to find the connection between achievement goals and help-seeking strategies in an intelligent tutoring system [44]. Another study discussed how certain strategies could be unproductive after looking at students' tendencies to request automated hints in an intelligent programming environment, specifically help abuse and help avoidance [25]. Neither study interviewed the participants to investigate why students chose those sources. Lastly, Price et al. ran an experiment to compare how programming students used an online tutor as opposed to a human tutor [37]. Subsequently, they interviewed the participants to understand the reasons for their actions and identified three broad categories: the factors that were not directly related to the programming problem at hand, the student's approach in assessing the situation, and the attributes of the source of help. While they did interview the participants, this study focused on tutors in a simulated situation with limited options rather than a natural setting that was dependent on what resources were accessible.

3   METHOD

Our study sought to bridge the gap between the extensive literature on social help-seeking in general and the comparatively sparse literature in CS education, investigating *what factors influence the social help-seeking behavior of introductory programming students in a highly competitive university environment*. We conducted a semi-structured interview with each participant (n = 32), followed by thematic analysis and qualitative coding on the ensuing transcripts. There is

a long tradition within the social sciences that aspires to create a rich understanding of the observed context through thick description [10, 12], so we sought to apply the same ideas to the broader context of the institution we selected. All details below were approved by our university's institutional review board for ethical treatment of human participants.

3.1 Positionality Statements

At the time of this study, the first author of this article was an undergraduate student at a different university than the one selected in this study and had no previous relationship or affiliation with the students who participated in the study or the instructor of the course. The first author was responsible for conducting all the interviews, and the unfamiliarity with the institution studied was an asset when it came to avoiding premature assumptions during the interview or the analysis and increasing the chances of being viewed as an external person by participants. Additionally, the similarity in age and stage in life might have helped build rapport between the first author and the participants. The first author was completing an internship as a CS education research assistant and had previously participated in two internships in CS (software engineering) research. They were a CS major at a small, liberal arts college who had their own experience taking introductory programming courses where collaboration and social help-seeking were encouraged and believed to benefit students. Furthermore, the author is a White woman who has experienced the pressures of CS as a male-dominated field and approached this research with the objective of eliminating barriers of entry by exploring issues that prevent success.

The second author was a computing education researcher at the institution studied with several years of research experience in the intersection of **human-computer interaction (HCI)** design methods and computing education. They collaborated with qualitative analysis but did not participate in data collection. Their expertise in qualitative coding and thematic analysis guided the analytical process.

The third author was a tenured professor at the institution studied, and the research supervisor of the first and second authors. The third author was not faculty in the CS department studied, though they do know many of the CS faculty who teach the courses taken by participants in the study. This gave them some informal, second-hand experience with the department culture, but only limited exposure to the student experience around help-seeking, which was largely invisible to them, as they were in a separate academic unit and not engaged in teaching CS courses to CS students. The third author used their relationships with CS faculty to gain access to the student community, and their familiarity with the CS curriculum to facilitate interpretation. They brought to the project a belief that the help-seeking culture of the courses would be fragile and disjoint given the competitive nature of the admissions process and expected racial and gender differences to surface in interviews given prior second-hand reports from students in the community. They managed these expectations by intentionally withholding them during the interview and analysis phases of the work but then brought them into the final phases of brainstorming interpretations and implications, which shaped this manuscript's discussion section.

3.2 Context

Primarily focusing on easy access to the student community when deciding on a location made for a favorable, convenient, and practical setup for this study to take place. Not only that, but the university selected for this study was a large, public, research-intensive university with a school of computer science and engineering, which allowed us to recruit from a large population in the hopes of diversifying our sample and amplifying the factors students considered. As of 2020, the overall population of students at this university was nearly evenly split between male and female (the data did not consider non-binary students), while the ethnicity was mostly White and about one-quarter

Asian. The ethnicity of the faculty at this university was similar to the student body; however, the number of male professors was much higher. Within the CS department, approximately two-thirds of students identified as male and three-quarters as White or Asian. The demographics of the faculty in the department were similar to the students. The instructor for the course in this study is a White man.

The introductory computing course that we selected taught fundamental programming skills using the Java programming language. No prior programming experience was required for this course, although basic algebra and computer skills were encouraged, and those with extensive programming skills were advised to consider registering for a harder course instead. The course focused on exploring common computational problem-solving techniques that would aid in the core objectives of the course, including writing functional programs, utilizing a variety of programming constructs, identifying and fixing bugs, overcoming difficulties by employing various resources, and explaining the importance of readable code.

The class was split into two instructor-led lecture sections with different time slots. The sections were taught by the same instructor and had approximately 250 students registered for each. The lectures occurred a few times throughout the week and involved the presentation of new concepts. Additionally, the class included a small group discussion session once a week that was taught by one of the teaching assistants, which provided supplementary material that was relevant to the content being taught that week in the lectures. Teaching assistants were also responsible for grading the students' assignments. On top of the formal class lectures, the instructor advertised established resources for obtaining help. This included a centralized tutoring center where all the teaching assistants held office hours, a course message board for asking public or private questions virtually, and the instructor's personal office hours. In order to guide students' study habits, the cheating policy was included in the syllabus to convey that sharing code is considered cheating and all submitted code must be entirely their own individual work. This strict plagiarism policy had a well-known consequence of deterring help-seeking among students.

The selected course was a prerequisite for upper-level computing courses in the CS major, along with other informatics and engineering majors. Despite being the starting point, the selected institution had competitive admissions for many majors, meaning students were required to apply in order to be allowed to pursue their intended major. Only a select number of students got accepted, which was partially dependent on grades from some of the courses they took. Among both faculty and students there was broad awareness about the competitiveness of this program. Prior work has shown that competitive enrollment policies in computing departments negatively predict first-year students' sense of belonging, self-efficacy, and perception of the department, which are all known predictors of student retention in CS [35]. In another study looking at large chemistry classes, similar conditions helped reveal a variety of help-seeking orientations among students [18]. We hoped the environment of our selected institution would help reveal many social help-seeking strategies, or lack thereof, where retention might be negatively impacted by the competitive enrollment policies.

In past years, the grade a student received in our selected course was considered for admission to the CS major. Just before conducting this study, however, the course grade was removed from consideration, although completion was still required. In addition, all students initially had to apply after they had already enrolled and started classes, but this transitioned to allow high school students to apply simultaneously with their college application. Due to this, some students had security in their major before arriving on campus, while others found themselves in an extra-competitive situation to fill the remaining spots.

When choosing the timing of the class, we tried to balance making memory recall easier on participants with having a class that mostly occurred in person, before the shift to virtual learning

Table 1. Participant Screening Survey

Item	Percent of sample (%)
Major	
Computer science/engineering	15
Engineering (excluding computer)	27
Informatics	12
Business/finance	12
Other	18
Undeclared	15
Computing experience	
First programming course	69
First college-level programming course	81
Race	
White	34
Asian	53
Black or African American	9
Hispanic or Latinx	3
Middle Eastern	6
Prefer not to disclose	6
Gender	
Woman	59
Man	34
Prefer not to disclose	6

due to the COVID-19 pandemic. The class that fit these needs occurred from January to March 2020, which was within the past academic year from the date of the interview and was mostly in person.

3.3 Recruitment

We recruited students who had taken this class through a class mailing list that was promoted by the instructor and provided an incentive for students to join with a $15 Amazon gift card. Potential participants were directed to fill out a screening questionnaire asking for background information about themselves and their academic experience related to computing. We used this to ensure the participants had completed the introductory programming course at the indicated institution and were 18 years old or older. All students who responded to the questionnaire met the criteria, so all were asked to schedule an interview. Everyone who completed an interview was currently enrolled as a student or had just recently graduated, so we refer to the participants as students.

Based on the students' self-report in the screening survey, the 32 participants were a relatively diverse group (Table 1). An overwhelming majority of students reported that this course was their first college-level CS course, and for two-thirds of participants it was their first programming course entirely. Five participants had declared or intended to declare a CS or computer engineering major, while many others had related majors, such as informatics. Only five students were undeclared, and one was a double-major in CS and a humanities field. Almost all interpreted computing or programming as important for their major. In terms of racial and ethnic identity, 17 students identified as Asian and 11 as White. Additionally, three students identified as Black or African American, one as Hispanic or Latinx, and two as Middle Eastern. Four students reported two ethnic identities and two preferred not to disclose. Finally, approximately two-thirds of the participants identified as a woman and one-third as a man, with two participants preferring not to answer.

In comparison to the student body of the school of computer science and engineering at this university, the population of participants had twice as many women and half as many men. Our sample was comparable in terms of race and ethnicity, with a slightly higher number of underrepresented minorities, which includes Black or African American, Hispanic or Latinx, and Middle Eastern students in this study.

3.4 Interviews

Prior to the interview, we gave participants a consent form outlining the purpose, process, benefits, and risks of the study. The document explained the procedure, how the data will be used, the method for confidentiality and anonymity, and their rights throughout the study. Participants were aware that the interviewer was not affiliated with their university, the information they shared would be confidential and anonymous, and their responses would be used to create a richer understanding of how students access and use resources that could benefit future administration of computing courses. We emphasized that anonymous quotes from the interview might be used in future academic publications without identifiers about the student.

Interviewees met with the first author through a confidential Zoom link and were given a chance to ask questions about the informational document they had received via email. Following that, consent was obtained verbally prior to starting the recording. We conducted a total of 32 semistructured interviews ranging from 20 to 35 minutes with different students over the course of three weeks. We audio-recorded and transcribed the interviews through Zoom, with a final round of edits and polishing of the transcripts completed by the first author. They also took hand-written notes throughout the interview to facilitate the discussion, but these notes were not directly used as data in the analysis.

During the interview, we asked students to reflect on the environment in and surrounding the class and the strategies they implemented when they encountered an obstacle in their progress. The structure of the interviews was split into three parts. The interview began with asking why the student enrolled in the class and what expectations they had for it. The second section focused on a specific instance where the student got stuck in their progress and how they overcame that difficulty. That was then used as the starting point for talking about broader social help-seeking behavior. We specifically focused on the factors that influenced whether they engaged in social help-seeking and how. If they did seek social help, we asked about who they turned to for help and why, as well as why they did not consider other resources that we were aware the class offered. Lastly, the interview concluded with a discussion about the student's overall thoughts of the class, if they were to continue learning computing, and what they might have done differently with their help-seeking strategies. The second section formed the majority of the interview. We've included some guiding questions from each section below. Given the semi-structured nature of the interviews, this list wasn't used verbatim.

- Section 1
  — Why did you choose to take the class?
  — What was your expectation going into the class?
- Section 2
  — Can you tell me about a concrete example of when you got stuck while programming individually in the class?
  — How did you try to get unstuck?
  — Did you consider asking someone for help?
  — Is this scenario that you described typical of your experiences programming for this class or unique?

- Section 3
  — Did your expectation match the reality of the class?
  — Can you tell me about your decision to remain in/leave CS?

3.5 Qualitative Analysis

The first and second author completed the qualitative analysis of the dataset. Using an inductive process, the first author created an initial list of codes based on the factors that influenced student social help-seeking that were identifiable in the 32 transcripts. This initial list was generated by scanning through notes they took while talking to participants, which assisted in the recall of important factors from the interviews. Additionally, the literature review that was conducted prior to the interviews assisted in creating a foundational understanding of factors that have been previously studied, which guided the authors when searching for patterns. The two authors met to discuss these codes and create structured definitions for each one, which resulted in an initial code set.

After that, the authors performed a round of deductive qualitative coding on the transcribed interview data of a randomly selected sample of 10 out of 32 transcripts. The data from the transcripts were split into sections based on the conversational turn-taking that occurred during the interview itself. Thus, we allowed for multiple codes during this process, because one conversational turn could contain many sentences, ideas, or pieces of evidence in it. The first author analyzed each transcript and identified where codes could be applied. The second author then analyzed the coded data afterward to confirm or dispute the application or absence of a code. The two authors met three times throughout the process of coding the initial sample of 10 interviews to discuss the reliability and validity of the code set and make adjustments as needed. After the third meeting, both authors agreed that the code set felt solidified and that it was relatively representative of the data. The first author then applied the updated code set (Table 2) to the rest of the transcripts to generate final results.

Our approach to analysis followed guidelines suggested by Hammer and Berland [13], which position qualitative data analysis as generating claims about data for future investigation, as opposed to testing claims through quantification or other methods. We therefore focused on developing consensus about the claims we felt the data supported, rather than trying to measure the reliability of independent raters' codes, such as using an inter-rater reliability metric. Discussion of disagreements is similarly instrumental in surfacing what aspects of the interpretation are more subjective under Hammer and Berland's approach, and we allowed for this in our analysis by meeting several times to refine the code set. Most disagreements in the application of the code set were minor and easily resolved with the clarification of code definitions. However, some of the larger disagreements included:

- The application of judgment and intimidation codes overlapped. After discussion, the difference was pinpointed to be whether it was perception about themselves (judgment) or perception about outside forces (intimidation).
- Whether an in-person code was broad enough. Authors decided to change this code to communication style.
- If the identity code should be limited to demographic variables. Based on the data, we broadened identity to include more, such as identity as a computer scientist.
- Whether the outcome of a help-seeking event was a reasonable code. Authors decided to remove outcome as a code, due to it only existing when a help-seeking event had already occurred and being a secondary influence.

Using this approach, we highlighted broad takeaways about the manner in which students seek help rather than closely examining each factor, given that there were usually a wide variety of

Table 2. Summary of the Student-reported Factors that Influence Social Help-seeking Behavior

Desire to complete alone	Participant wanted to achieve a task without help or assistance.
Prior experience	Participant described how their prior experience with computer science courses impacted their social help-seeking behavior.
Cheating policy	The university policy that emphasized the consequences of plagiarism and limited what information teachers and teaching assistants could share.
Resources	Participant's help-seeking behavior was affected by knowledge of or access to resources.
Type of question	Participant's approach changed based on the description of their question.
Convenience	Participant decided that one option was easier than another.
Explicit class standards	Information provided by an authority figure or institution.
Judgment	Participant held a fear of being perceived in a negative light by the help-giver or surrounding individuals.
Communication style	Participant preferred the presence of the help-giver.
Consistency	Participant used the same strategy for getting unstuck as they had done previously.
Chain of order	Participant described a "right order" for who they should ask questions of first before escalating.
Intimidation	Participant felt intimidated by an individual, an environment, a context, etc.
Familiarity	Participant referred to the help-giver as a person they know or that knows them at a deeper level.
Mutually beneficial relationship	Participant described a relationship with others that is predicated on mutual assistance rather than unidirectional tutoring.
Trust	Participant believed that the resource was credible or "should work."
Identity	Participant's identity, or looking at another person's identity compared to theirs, affected their choices.
Competition	The major and the class were set up in a competitive way so a student's success could be dependent on the success of other students.
Implicit class standards	The culture and unspoken norms of the class or the environment.

student perspectives on any given source of help. Furthermore, not all participants followed the patterns outlined in the discussion section, but this was often due to the general lack of needing assistance to complete their work.

4 RESULTS

Our results revealed 18 student-reported factors (Table 2) that align with the steps Newman outlined in the adaptive help-seeking process, including determining their need for help and who can help them [32]. Across these factors, our results showed that the students saw two steps in the process of seeking social assistance: (1) the initial decision to seek social help and (2) the subsequent decision of who to approach. We begin by describing the factor that is a fundamental barrier to social help-seeking: desire to complete alone, followed by explaining the factors that influence the decision to seek social assistance and the factors that influence the choice of who to ask for help. We list and define the factors and provide explanations and examples for each. For readability, factors from (Table 2) are underlined.

There are two important notes for consistency:

— In the interviews, participants called the teacher of the class the "professor," whereas we use "instructor" to avoid confusion with titles and ranks. For the purpose of this article, the two

terms should be considered synonymous when reading the quotes, as they are referencing the same individual.

— The participants used the terms "programming" and "coding" interchangeably. While we previously used the term "code" to discuss the process of qualitative coding (Section 3.5), for the rest of the article "code" is used to describe a computer program, while "factor" is used to describe a theme identified through our qualitative analyses.

4.1 Fundamental Factor: Desire to Complete Alone

We found that the baseline barrier to seeking social help is the desire to complete alone, where a participant wanted to achieve a task without help or assistance. For example,

> P3: *I was really proud of myself for being really stubborn and being like, oh, I'm going to do this myself. There were even times where I had my code, but I didn't like the way I did it so I like, deleted everything and redid it. I was very passionate about that class.*

The first step after a student acknowledged that they were stuck was to decide on a course of action. The precursor to seeking social help was to decide that social guidance would be the approach they wanted to take. Many students expressed their desire to avoid interacting with other people for a variety of reasons, four of which were repeatedly mentioned. The first was the belief that working alone leads to deeper learning, and that a better understanding of the material will benefit them in the future in other classes or jobs.

> P19: *Figuring it out by yourself, you'll learn the most. And since I'm taking a course to learn. Anyways, like, that's the most beneficial way. And I always, I think it's just satisfying that, to know that even though you were stuck for a long time, you were able to figure it out by yourself at one point, especially for things like CS, because it's kind of a puzzle.*

The second reason was that the initial first step should always be to try to get unstuck alone, because asking for help was a last resort in order to respect the time of the help-givers and the needs of other students. Third, many students expressed that working alone was a habit they built, either from prior classes, their high school, or the idea that programming is a solitary activity.

> P17: *I think coming from like, a math background, where you don't have labs and other things you just learn to learn out of the textbook. And that's kind of like, a widely accepted thing especially like, in pure math or higher level math.*

Lastly, many mentioned that solving a problem alone was private.

> P27: *I prefer to experiment and like, have my failures in a more private setting, so that's what I chose to do.*

4.2 Step 1: Decision to Seek Social Help

Whereas some students had a strong desire to work independently, others felt encouraged to work alone because of other factors. First, by prior experience: the participant described how their prior experience with CS courses impacted their social help-seeking behavior. The lack of prior experience in computing discouraged students from seeking social help, due to feelings of embarrassment. Often, the lack of prior experience co-occurred with judgment or intimidation, which will be discussed later in this article.

> P2: *Sometimes I felt intimidated by the other people who were in that seminar because it seemed like they just had so much more experience with programming than I did. And that did make me kind of feel like, oh like, can I like, can I be successful?*

On the other hand, more prior experience either led students to feel self-sustaining without social support or allowed them to feel more comfortable reaching out for help.

> P5: *Because of my prior experience I felt very self-sustaining. I didn't think I would have to really like, you know, raise my hand during lecture or maybe quiz section to ask a question about some kind of code.*

In addition to past experiences, some students were affected by the cheating policy, the university policy that emphasized the consequences of plagiarism and limited what information teachers and teaching assistants could share. This policy was the rule that had the largest influence over students' social help-seeking behavior. Many avoided working with peers or friends entirely out of fear of being penalized:

> P2: *They have such a strict policy about like, collaboration. I felt like it was kind of almost risky and I didn't want to like, do something that would have been academic dishonesty like, accidentally. Um, yeah so I didn't really want to talk to peers because of that.*

This was especially true for international students, where the consequences of breaking a university policy, including the cheating policy, were much more extreme:

> P32: *I think that's a similar fear that a lot of international students have, because for us, the stakes are higher. It's all, it's also about a visa. It's a lot about our investment and everything, you know, like, you don't want to get up into like, crazy stuff like this and, you know, get into like, academic probation and things like that, because I don't, we don't know how to get out of those things, you know? We don't have the right support system to like, back up on those things. So I feel a lot of international students, even in my community like, the people who took [the course] earlier and who are taking [the course] with me, I felt all of the international students felt very similar to what I'm thinking right now, you know, so that's why I think that kind of like, you know, that risk factor meant a lot for me … I just wanted to avoid that to like, to the most extent.*

The decisions students made were also limited by their understanding of the available resources; the participant's help-seeking behavior was affected by knowledge of or access to resources. Uncertainty, doubt, accessibility, and the assumptions that students had about the resources they could use affected the probability of using a source. When students felt uncertain about how a specific resource operated, they were less likely to use it. For example, the setup of the tutoring center was not always straightforward, which deterred some students from trying it. Regarding the same source, the doubt that it would provide them with the guidance they needed also reduced their chances of trying it out. Despite that, the ease of access to some resources encouraged students to test it out. Many felt that the tutoring center was accessible because of the long and frequent hours. Another part of the class, the quiz section, created a window of opportunity for students to ask questions while in class. The accessibility of this option encouraged students to approach the teaching assistant with questions. Lastly, the students made many assumptions about the resources they had heard of. One assumption was that they had all the tools necessary to complete an assignment without help and, therefore, should work alone:

> P3: *I just think the way the teacher taught us like, the topics was so good that I could figure it out by myself. He gave us really really good examples, and then when we had quiz sections we got those guides. We had like, what each topic meant and some examples and the answers to the examples which was very useful. So I felt like I have all the tools to do it myself. I just have to like, really get into the mindset.*

Furthermore, students felt a question had to be of reasonable merit to warrant asking it, pushing them to consider the type of question; students' approach changed based on the description of their

question. Many students felt the size of their question was too "small" to justify asking it, so they worked alone instead:

> P24: *If it's like, small issues, I tend to not go to the [tutoring center] because it's a whole process to get on the, get on the third floor.*

However, believing their question was "stupid" was the most detrimental and prevented any form of social help-seeking entirely.

Merely the logistics of social help-seeking had a big influence. One common factor was convenience; the participant decided that one option was easier than another. A few options were connected to this factor, namely timing, location, speed, and effort. Students used the influence of convenience to explain every preference, including working alone. A reoccurring reason for not seeking social help was that their question was too "small" to make it worthwhile to invest the effort:

> P30: *It felt a little bit inconvenient to like, if it's just like, a small bug I, it felt not really worth it to walk all the way somewhere to figure it out.*

Another component of the logistics were the rules, which are encompassed in the explicit class standards, information provided by an authority figure or institution. Many students changed their behavior based on the course's homework. Students concerned with the grade they would receive often visited the teaching assistants, since they were tasked with grading all homework assignments, as a method of checking their work. Furthermore, when a deadline was approaching, students more quickly sought out help instead of persevering alone:

> P29: *There's a few of these moments. One of them is one like, the due date is the night of and I still haven't figured out how to finish like, this last method. Then I'll go to the [tutoring center] and then be like, "okay, please."*

In addition to logistics, some students strongly avoided possible judgment; students held a fear of being perceived in a negative light by the help-giver or surrounding individuals. Many students expressed a fear or concern about appearing "stupid" in front of the help-giver, which could cause them to not ask others for help entirely. The idea of appearing "stupid" manifested in a variety of ways, such as the reluctance to show they were doing badly on an assignment, worrying about not being able to understand the answers to their questions, asking for help on concepts that were already covered in class, or the fact that they were struggling in an introductory class:

> P4: *I feel awkward after asking [the teaching assistants] like, for several times, but I still don't understand. And that just became awkward afterwards. And then, "oh, could you explain that again?"' this is just kind of awkward and seems like I'm too stupid or something.*

> P6: *I think it's more understandable to not, to be struggling at a math subject, than like, personally, I feel like it's more embarrassing to be struggling at the like, low level CS class and also I think I'm a lot better at math than I am at CS. I think that probably contributes to it where I feel like, more confident to ask my questions because I recognize that they're like, a real question that I really puzzled over and I couldn't figure it out, versus like [the course] where I might have been making the most like, basic little kid mistake and I just had no clue.*

> P17: *I don't spend a lot of time, preparatory time getting ready for assignments as other students, I feel like. So I feel like I'm taking away from other students that are more prepared when I go to the professor and I'm like, or, or the TA, whatever office hours, and I'm like, "hey, I don't understand this." And they're like, "this was like, material from a week ago" and I just feel stupid.*

Most students felt more comfortable asking for help from peers, unless they perceived themselves as a bother and were disinclined to waste another person's time.

4.3 Step 2: Deciding Who to Ask

After overcoming any potential barriers and determining their need to seek social help, students were faced with the decision of who to ask. While only some of the factors we uncovered impacted the decision to ask for help, all of the factors, aside from the desire to complete alone, played a role in who to ask (Table 2).

4.3.1 Communication Preference. To begin with, just as some students believed they should work alone, some students were partial toward a certain communication style; the participant preferred the presence of the help-giver. Many of the students who did seek social help ascribed the reason to their preference of working with the help-giver in person, as opposed to using virtual means.

> P22: *I would usually just go to the, the [tutoring center] and just ask a TA for help. I mean it was just the easiest way I think. Um, sometimes I would email my quiz section leader. I don't think that was usually my first instinct, my first instinct was usually just to go to the [tutoring center] and just, you know, get help there because I think it's easier for, you know, a person, to be in person and explain, you know, what you're doing wrong and I don't know, it's just like, a faster and more efficient way to get help from a TA.*

This preference stemmed from a wide range of reasons, such as greater efficiency, deeper understanding, ability to ask multiple questions, or the enjoyment of the discussion component.

> P3: *Every Saturday morning, we would like, meet up and work and it just made me enjoy the class a bit more.*

However, a few disliked in-person or discussion-based communication.

> P27: *Well, I wasn't quite sure what the process would be for like, asking for help ... and so I was a little nervous. So I just sort of come in there and sit down at a computer and not know if I was supposed to like, approach someone and just end up kind of sitting in the [tutoring center] for a while and not accomplishing anything ... Yeah, mainly that and like, the fact that there were so many other people who are around there and I don't feel very comfortable like, being lost or unsure what to do with a lot of other people around.*

Lastly, some believed written communication to be more efficient.

> P17: *I prefer [asking questions] over email just in general, because if it's a quick question like that ... You know, I don't [ask questions] in a group setting. I feel like I'm taking way more time if I have to like, get a question and get an answer that's just for me. And I know it might be helpful for other students, like that's kind of the point of everyone being there and listening to the questions, but like, I just prefer to shoot a quick email if I'm like, "hey, am I missing something like, where did we cover this?" You know, "what chapter is this?", "what lecture?", and then just go from there. So I prefer to do things like, through email or Piazza or stuff like that.*

4.3.2 Logistics. Just as aforementioned, logistics had a large influence on the students' decisions. Convenience, resources, and the type of question also affected the decision of who to ask. In terms of convenient timing, most mentioned the limited amount of office hours that the instructor held, whereas there was an abundance of hours open for the tutoring center that fit their schedule better:

> P2: *I think the, the tutoring center hours, since they just were open like, most of the time, and his office hours were like, one or two days a week, it was just more convenient for me.*

Many also praised the location of the tutoring center as being easily accessible in the center of campus, whereas others explained that the effort of walking to the location was too great. The tutoring center regularly involved waiting times, and the time wasted on waiting for a teaching assistant to be available was often too big of a burden. Others still saw virtual help as more efficient, as they did not have to physically move and had access to many people at once:

> P7: *Proximity to [my friends] is definitely a lot easier, just to text them than to email a TA and then who knows when they get back or the professor, you know, for. Sometimes it can take them hours when I could just easily talk to my friends in five minutes and then be on my way.*

In terms of the students' awareness of the available <u>resources</u>, many believed that asking the teaching assistants or the instructor were their only options, which led many to just pick between those two.

> P1: *Well at least I'm, yeah, I, I was unaware of any other ways to get help if there were any. Those were the main two ways that I knew of.*

The practicality of who could help with a particular problem pushed students to think about the <u>type of question</u>. Many students used the messaging board because there was an option to be anonymous. When it came to the content of the question, many believed that questions about code, style, or grading could only be answered by the teaching assistant:

> P5: *If the problem required me to show my code to someone, I felt like I had to turn towards the TA. I would either tell them the logic of my code or send them a small snippet of what this is and just be like, "hey, this isn't working" or "hey, I'm not sure if I'm allowed to use these certain functions, functionalities in this program."*

Generally, many would turn to friends for more conceptual information or when working on additional practice problems. Many theorized that the only reason to approach the instructor was for administrative questions. When students had multiple questions, they believed attending office hours would be the best option and reached out to friends for quick questions. Believing their question was "stupid" prevented students from approaching teaching assistants or the instructor and they turned to friends instead.

In addition to the <u>type of question</u>, some students mentioned, either directly or indirectly, a <u>chain of order</u>; the participant described a "right order" for who they should ask questions of first before escalating. It was very clear that the majority of the students had an implicit, "correct way" to address their confusion. Only one student explicitly mentioned a <u>chain of order</u>, yet many mentioned a series of steps for who to ask first, second, third, and so forth.

> P7: *I just thought like, the chain of order I would go if I had questions, it would probably start, I had two friends in the class with me. So if I ever had any clarifications, I would just whisper to them during lecture and then if it was out of lecture potentially, I would go to, the TA would be like, the second option, and then, it never really got to the point where I had to go to [the instructor].*

This was also shown through discussing guidelines or rules they followed, where expressions such as "last resort" were used frequently:

> P28: *The [tutoring center] for me seems to be something that's like, I don't know, like, I always just viewed it as the last resort, sort of a thing because it was probably the most effective, but since there's like, a limited staffing um, you know if, if all 500 of us computer science students showed up in that little room, we're going to be waiting quite a while to get any help. So for me it was just more like, I wanted to keep it open for others for when*

they need it so that in the same case when I need it and I need it to be open, hopefully I can get the same treatment that I am helping others get.

There were two common chains, depending on if the student avoided working with peers because of plagiarism concerns. The first step was trying alone, followed by asking peers, teaching assistants, and the instructor.

P4: *So usually when I got stuck to, with a problem, I usually try to, try and, try to solve it by myself for like, hours and then if it doesn't work, go find a friend. And then I'll ask if I just can't get, just can't get to understand what that means, I will just go to the [tutoring center] probably.*

The second common chain simply eliminated the second step with peers. Furthermore, the step regarding the instructor was often excluded, because it rarely came to that:

P8: *I guess the professor really would have ... I never really had a question that I didn't, I felt like only he could answer.*

A few variations depended on the <u>type of question</u>, and many skipped asking friends if they wanted to talk explicitly about code:

P20: *Normally I'd go to my friends first. I mean I, for me, this is for all classes, I can say is if I get stuck I'll always go to my friends first in the hopes that if it's a really quick question I can shoot them a text and they can respond, you know, really quickly. And it's accessible. It's easy. Office hours is a more, you know, going to office hours is more of a time suck of going there, waiting, you know, until the teacher can get to me, asking my question. And if it's a short, just a short, one, little, you know, one sentence answer, I'm going to go for that. But if then, a friend can't answer the question, or it looks like it's going to be a longer or in depth explanation, then I'll go to office hours, I would say.*

There were a few noteworthy exceptions to the chain. Some students preferred the teaching assistant over the instructor, despite their higher rank, and some preferred friends over the teaching assistants because the teaching assistants were limited in the information they could provide, which made the quality of help equal and other factors more relevant.

Similar to the <u>chain of order</u>, many students built a habit and focused on <u>consistency</u>; the participant used the same strategy for getting unstuck as they had done previously. Once a student found a source that worked for them, they typically would return to that source, whether it was friends, the teaching assistant, or another person:

P9: *So the [tutoring center] was, it was second home for me winter quarter, um, some TAs were amazing.*

P26: *I was stuck and I've heard good things about [the tutoring center], so I went to go try it out. And then when I, when I went, I thought it was really helpful. So that's why I kept going back.*

The only reason students reported altering their behavior was if their usual source was unavailable or could not provide a sufficient answer, which caused them to proceed to the next step in the <u>chain of order</u>, as aforementioned. Furthermore, a common complaint about the tutoring center was the individual teaching assistants that were available would change every visit. Therefore, the advice was inconsistent. This shows that the students valued <u>consistency</u> from their social support.

4.3.3 Social. Comparable to the weight <u>judgment</u> held when avoiding asking questions, students frequently considered the people around them when deciding who to approach for help.

Judgment is about who students felt most comfortable working with, which often meant students relied on help from friends or close peers. Some students were worried about the potential negative responses they could receive from help-givers and preferred an anonymous option. Others tried to push past their fear of judgment to get the help they needed:

> P9: *I think for me it was just like, a more of a personal journey, figuring that out and like, understanding that it's okay. But I also just like, felt that people might judge me because I'm there so much or they're like, "oh my god this girl still doesn't get it." So there's definitely that like, slight little mentality that happens, but I tried to push away from that. I mean, I did cry a couple times in the [tutoring center], but I think that's normal.*

While judgment was about the possible negative perceptions about the student themselves, some focused on the help-giver and reported feelings of intimidation; the participant felt intimidated by an individual, an environment, a context, and so forth. When asked about reaching out to the instructor, the nearly unanimous answer was that they never considered the option, which was affected by the extremely large class size. Feeling intimidated was a commonly cited reason, given that the instructor was viewed as "too smart," "scary," or "too busy" for repetitive or insignificant questions, despite an absence of active intimidation.

> P9: *[The instructor's] just so busy. They're all busy people and it's a class of 600 like, at some point like, I do understand like, not every student-professor dynamic is going to be the same, especially like, in terms of the class size.*

> P11: *I didn't [attend the instructor's office hours] just because, I don't know, I think I felt kind of intimidated to ask the professor. I mean, he seemed really nice. He always emphasized how there's so many, there are open hours for TA office hours. So, so yeah. I think I was just intimidated to sit down with him and like, work on small little errors in my code. So I didn't."*

Most students developed this idea without even attempting to visit, with many suggesting that it was a standard they adopted from other university classes or from hearing the instructor encourage them to connect with teaching assistants instead:

> P17: *I feel like math is really harsh. So you go to office hours and they'll be like, really condescending and that's fine, but it's, it's just how it is. Because, math is a tough subject and I don't think they mean to, but a lot of times you'll ask a question in office hours in a harder math class and they'll just look at you like, "are you kidding me with this question?" So I know other, that TAs are a lot better than like, professors in that. But in general, I feel like professors can be kind of harsh and so yeah. I, if I were to choose someone it would be a TA over a professor, because I always feel more comfortable and I don't want to be like, looked at in a bad way by the professor. And I'm not saying that like, they should look at me in a good way when I ask a silly question. I'm just saying that that's how I feel and I prefer to do things either with, you know, friends in the class or just online.*

A few students were intimidated by the idea that other students knew how to code already. One noteworthy point is that some students were intimidated by the environment of the tutoring center, due to how busy it was and the lack of clarity about how the system worked.

The previous two factors explained a lack of comfort between the student and the help-giver, whereas some students focused on familiarity; the participant referred to the help-giver as a person they know or that knows them at a deeper level. Many students who had friends in the class or with prior experience in programming expressed increased comfort levels and a

preference for asking them for help. This was mostly attributed to the reassurance they felt in showing their faults or errors:

> P19: *I think it's just my own personal thing where I'm just like, I don't want to seem incompetent to other people. And I know that TAs are there to like, help people who really, who are struggling, but since I was already close to my friend and he knows that I have no CS background, then I think just knowing that made me feel more comfortable going to him.*

Some also mentioned the <u>convenience</u> of working with friends or the enjoyment of collaborating with someone they know well. Others avoided working with friends even if they had the option, due to the concern of accidental plagiarism or believing it would be more distracting or unprofessional:

> P10: *I just know that like, from a third party it can, I'll just get like, exactly what I need, which is help on the problem itself and like, there won't be any like, tangents, and it'll be pretty efficient the way that they express the problem. And then I also know that there won't be any, it'll be very objective, especially since I know my friends might have already done the assignment before.*

In addition to the level of <u>familiarity</u>, some students mentioned <u>mutually beneficial relationships</u>; the participant described a relationship with others that is predicated on mutual assistance rather than unidirectional tutoring. For example:

> P26: *I definitely would have liked a group of peers, for sure. I think that would have, it would have been nice just to, just to talk about the assignments or even just like, as a way to like, make sure that we're completing the tasks on time and just being on, being like, what do I want to say. Just making, just looking out for each other's backs. I think having, having peers for that.*

The consensus was that students were more likely to ask a friend for help if the relationship was mutually beneficial:

> P12: *[My friend is] also taking like, the exact same courses. We've taken classes like, all together since freshman year. So we've just known each other and like, we're always like, in the exact same classes. So it's just really easy because we're always doing the whole like, work at the exact same time. Yeah, and I think we could say, though, like, we're fairly similar to that when it comes to skill level and coding.*

Some felt more inconvenienced having to ask friends that weren't working on the assignment already, and others felt it was unfair to ask friends when it wasn't their job to teach them. Some preferred asking the teaching assistants, because tutoring was their official job:

> P20: *I feel like it's unfair to my friends in that class if I have to, they have to like, sit down and explain a concept to me for like, 20 minutes or for me doing the same thing, that whereas that's TAs' and teachers' job, so I feel better going to them for that.*

Furthermore, seeking out a particular source was contingent on <u>trust</u>; the participant believed that the resource was credible or "should work." The qualifications of the help-giver were critical in determining who students should ask for help from. The idea of getting quality help and the assurance that their problem would be solved was instrumental in their choice. Those who turned to friends described their experience with programming and competence:

> P31: *I mean, mainly just that if I have friends in the course, and I see them as, you know, being competent, you know, to a level that would be helpful to me then, that's always my first point of contact, because you know you trust your friends and things.*

Those who chose the teaching assistants also mentioned their background in programming and CS, but additionally mentioned their knowledge of the course, the assignments, and the university's policies, including the cheating policy:

> P10: *There's a lot more factors when it comes to asking friends for help, whereas with the TAs, they know exactly what the course is and they know what we're learning and the way that they help us is like, they're trained to help us for [the course] specifically.*

This was limited by the information that the teaching assistants could provide, due to the cheating policy, which occasionally made them unreliable sources of help.

4.3.4 Self. Not only was trust in others important, but also trust in their own ability. A student's prior experience encouraged access to all available resources, while a lack thereof caused students to avoid specific sources of help, such as the instructor, and turn to more familiar people.

Not only that, but students were affected by their identity; the participant's identity, or looking at another person's identity compared to theirs, affected their choices. There were a variety of identity features that were brought up. The four most prominent ones were their CS identity, student identity, racial or ethnic identity, and gender identity. Many students declared they were not a "CS person," which often meant they did not feel qualified to speak with the instructor of the course. Furthermore, feelings of imposter syndrome [39] led many students to avoid asking for help.

> P9: *I feel like I didn't understand it the first time, and I feel like if you're, if you are more of a CS person or you're like, good at CS then you just understand it the first time. And that was definitely not me. So I think at that point I just knew that it's not fit for me.*

As a student, getting help from another student or peer felt more comfortable because of that similarity or because of their shared experiences. This sometimes led them to seek help from TAs rather than the instructor.

> P19: *TAs are closer age-wise too, and since they were students or they were once students for the class, I feel like, even if you don't know something, then, they, since they recently experienced it I feel like they would understand more.*

Racial and ethnic identity and gender had similar effects on students. The only students that mentioned these categories identified as members of marginalized communities and explained that increased diversity increased their comfort levels in the classroom, as well as when asking for help. A few students also felt increased pressure to represent their identity, so they were extra cautious with their social help-seeking behavior for fear of leaving a bad reputation.

> P6: *Especially for like, a STEM class I tend to gravitate towards having a female TA just because of multiple times where like, I feel like men and male TAs have definitely judged me for being in the class and so I've done my best to like, try to seek out those female TAs and those female faces.*

> P31: *I like, don't ask questions that I feel like would come across as incoherent, you know? So, I don't know, but that's, that's like, part of, that's part of me. So I've always been like, I've always felt that way. Yeah, because either way I don't want to like, give a bad name to like, you know, women, or people of color in STEM. So I'm like, I have to be overly competent so that it doesn't like, look bad on other people. So yeah, so I would say like, my identity definitely plays a role in how I act around others in classes and stuff.*

4.3.5 Environment. There were also many factors shaped by the institution that influenced social help-seeking. Perhaps the most prominent were students' reports about competition; the major

and the class were set up in a competitive way so a student's success could be dependent on the success of other students. For instance:

> P2: *It's so competitive and it's so hard and like, in the intro classes people can be really cutthroat because they're trying to get into the computer science major.*

The competitive nature of the introductory programming course led to many similar sentiments that judgment brought about, in part because of their expectation that most students knew how to code:

> P6: *I was like, I shouldn't have taken this because every person, every person who's taking that undergraduate CS class is like, there because they're trying to get into, they're already either in the CS major and they're like, "I'll just take it as an easy class" or they're all like, really grinding to try to get placed, even though like, no students get placed if they're not inside the major. So I just felt like everybody in there was like, cutthroat, and I was just there like, because I had to be there.*

> P29: *It was like, very scary and I knew that it was like, going to be a cutthroat type of class and competitive in some ways and a struggle. And I'd never coded before either, so that was like, scary as well because I knew that kind of a lot of people go into it with coding experience, even in [the introductory course], so it was like, scary to be on the spectrum of like, I have no idea what this is going into it.*

Students expected a lack of collaboration or guidance from their peers and would turn to teaching assistants instead. This was a major source of stress:

> P9: *I knew [the university's] computer science program was kind of cutthroat, not like, in a terrible way, but it is very competitive and a lot of people want to do it. So I anticipated [the course] to just kind of be like, that regular weed out class that like, no one's going to help out, you're just kind of on your own. And that's how it kind of was and it's what I expected because that's just how some weed out classes are at [the university]. So at least I kind of knew that coming into it so it didn't like, you know, shake me to the core. I was mentally preparing.*

While the competitive nature indirectly shaped how students viewed each other, a direct influence was the cheating policy, as aforementioned. Those that did choose to work with friends intentionally emphasized that they never showed code to each other and that the help was mostly in the form of hints. Most students, however, trusted the teaching assistants more than their friends in regards to the cheating policy:

> P21: *I think because of the academic dishonesty and like, misconduct rules that they have it's just better safe than sorry than asking any of your friends because you don't know what's considered okay and not and I guess you can trust that the TAs will do the right thing.*

This was especially true when students wanted guidance on pieces of code. However, this policy also placed a firm limitation on the guidance or information the teaching assistants could provide, which caused many students to feel frustrated or avoid using this source entirely:

> P2: *There were like, a couple times where I felt like, um, I know that they're not supposed to like, tell us the answer necessarily just supposed to guide us so I, I remember maybe like, one or two times feeling a bit frustrated or like, like, feeling like they didn't understand what my question was.*

> P23: *I'm pretty sure the [tutoring center], they're instructed to not give the answers. So I always felt like I was leaving without a certain answer. So I always felt like I was unsure of what I was supposed to do most of the time. So I liked someone who wouldn't ask me*

leading questions about, you know, the stuff that would lead me to the answer. I'd rather just have them tell me this stuff because I would question myself a lot during this time.

Sometimes, certain suggestions acted similar to rules when given by an instructor. Explicit class standards also influenced students' choice of who to approach. The instructor highly encouraged students to seek help from the teaching assistants. Coming from an authority figure, many followed this suggestion or saw it as the only choice. This deterred many students from attending the instructor's office hours:

P16: *He would like, the professor in the class would constantly, and in like, our section classes they would constantly remind us that [the tutoring center] existed for us to like, go to and that we should go there if we like, needed help. So it was just like, at the back of my mind already.*

P18: *I definitely, a lot of times went to the [tutoring center]. I went to [the instructor] once … and I felt like I was referred to go to the [tutoring center]. It's not that he wasn't nice, but he definitely mentioned that the [tutoring center] would be able to answer my questions as well, or even better.*

While the above were explicitly stated by the instructor, some factors were part of the implicit class standards, the culture and unspoken norms of the class or the environment. The most recurrent description of the course was calling it a "weed out" class.

P9: *It's just like, I'm used to like, I was in [a different major] already so like, I'm used to like, smaller class sizes and like, one-on-one time with like, professors and it's a collaborative based major so like, I was already kind of like, spoiled in that sense, where I was used to working with people. So then, like, you put yourself in like, a weed out class and you're like, oh no it's freshman year all over again.*

There were a couple of consequences that came with this label. To begin with, the lack of collaboration was a large component, where students believed that others did not want to help them. Furthermore, students were embarrassed to ask other peers for help because they assumed other students were much more experienced and knowledgeable:

P10: *I think it's just honestly my own insecurity, just because I feel like I myself didn't have a lot of programming experience before [the course] and in my mind like, the impression that I have on this school is that everyone knows how to code, even though that's not, that's definitely not true at all.*

Due to the "weed out" culture, students believed it was normal to spend an unduly large amount of time working on assignments or in office hours, which caused heightened levels of stress. A few noted there was a pretentious STEM culture, where students believed they needed to be the best and show no weaknesses:

P31: *I do have a preference for like, reading through things on my own before reaching out to other people. Just because, I mean, I want to make sure like, I know what I'm asking. And I know what I'm talking about. Because I guess some of that is like, I don't want other people to see me as incompetent, you know? So, and CS does have like, you know, a stigma around it, of like, if you don't know what you're doing then you don't belong.*

A mixture of this culture and the large class size made it very difficult to make friends, which reduced the level of teamwork or peer support. It also prevented students from engaging with the instructor or teaching assistants because they viewed their questions as insignificant or not complicated enough:

P14: *My experience with learning is that I've always worked like, learned best like, working with people … And then just in my experience with like, STEM classes at [the*

university] like, people aren't necessarily like, the most friendly like, everyone's pretty like, introverted and like, keeps to themselves and so I was a bit like, concerned that like, I wouldn't necessarily be able to form a study group and then as, and especially a study group with people that I felt comfortable studying with because there's like, this very, kind of like, like, pretentious like, STEM culture at [the university] and I feel like, hmm. I've been in study groups where it kind of turns into like, this competition and like, people aren't actually like, interested in like, learning like, it's more about like, you know, who got it right. And like, I don't know.

5 DISCUSSION AND CONCLUSION

The purpose of this study was to answer the question, *what factors influence the social help-seeking behavior of introductory programming students in a highly competitive university environment?* We found 18 interacting factors that significantly guided how students engaged in social help-seeking throughout their introductory programming course at the selected institution (Table 2). Across these factors, our results showed that the students saw two steps in the process of seeking social assistance:)1) the initial decision to seek social help and (2) the subsequent decision of who to approach.

5.1 Contributions Relative to Prior Work

Past work on help-seeking or social help-seeking in CS has focused on online sources [7, 14, 15, 36] or intelligent tutoring systems [37, 44], instead of examining the broader social and institutional context of social help-seeking. In current learning environments, online sources and social resources are not formally distinct from one another, and intelligent tutoring systems are not widely available to computing teachers and programs. While these educational tools are important to understand for specific scenarios or future possibilities, they do not provide the contextual information that is necessary for improving our present-day educational systems. Our work addresses this gap by studying the impact the sociocultural context of a competitive university environment has on social help-seeking in CS, offering factors for future work to investigate more deeply.

Our work reinforces Newman's model outlining the steps students take when focusing on the use of social assistance: understand the difficulty of the task, determine their need for help, prepare their question, determine who can help them, and use the information they receive from the target source [32]. Specifically, we concentrated on two key pieces of Newman's model, the decision to seek social help and the decision of who to contact. We found that students who did not seek social assistance felt an immediate barrier that prevented them from reaching out for help. The barrier could have discouraged the acknowledgment of needing help entirely or motivated students to use solitary problem-solving strategies. For those who did desire social assistance, assessing who to ask could have been an intimidating task or another hindrance. If students did not believe they had the proper support, no matter what the reason was, that became another obstacle that impeded obtaining necessary guidance.

Just as Newman concluded that help-seeking is inherently connected to social interaction [32], we found the social component of problem-solving to be inextricably linked to the task of getting unstuck. Our data suggests that all but one of the 18 factors, desire to complete alone, impacted the participants' choice of who to ask for help, whereas just under half were justifications for seeking social assistance to begin with. When students were asked how they overcame their confusion, many immediately spoke about social help-seeking solutions with no separate step for non-social help-seeking. Moreover, most students in our sample engaged in some form of social help-seeking at least once throughout the course, similar to the findings in Knox's dissertation [20], but unlike the findings from Falkner et al., which stated that social help-seeking is an infrequently used method [9]. Those that did not seek social help either did not get stuck or did not get stuck badly

enough that they could not solve it on their own with minimal effort. Many students in our study also referenced the desire to use social help-seeking more habitually, recognizing its potential benefit for their learning.

We found that similar factors are present in prior work in the fields of general education and psychology that regulate social help-seeking behavior [4–6, 8, 19, 40–43, 45]. In addition, when Knox looked at how students engaged with programming in physical spaces, with reaching out to members of the community being one important way, many similar themes emerged. For example, they found that some students engaged in "safe asking," which is approaching a non-judgmental close friend, even if that means they are not the most knowledgeable [20]. Most students cited a multitude of reasons for their choices. At times, the barrier was consistent throughout the process, and other times, the various decision points presented different barriers. If the prospects looked bleak, the students determined that relying on themselves or non-social methods were better. Regardless, the steps that Newman outlined were present in their responses. Therefore, our results reinforce that help-seeking in a competitive CS context is not fundamentally different from help-seeking in other learning contexts.

However, the unique context in which our study was conducted played a role in the students' responses. To begin with, a core element of introductory programming courses is the code itself. A few factors were influenced by that component, including communication style, type of question, and cheating policy. When code was involved, the students adjusted their approach due to the complexity of talking about code, the difficulty of debugging, or the worry of accidental plagiarism. If the type of question related to specific lines of code, most turned toward the teaching assistants for guidance and avoided engaging with peers entirely. Working with code was new for most students, so being concerned about how the common idea of plagiarism applies to code is reasonable. Moreover, asking questions about code can be complicated when it is new, leading many students to seek hands-on assistance. Debugging can be a long, arduous process; therefore, asking for help in person was often preferred because of the opportunity to ask follow-up questions in a timely manner.

Furthermore, the environment played a big role as well, given that not all programming courses are taught in the same way. These were factors such as cheating policy, competition, explicit class standards, implicit class standards, chain of order, and intimidation. The university where this class was taught had a constricting, competitive, and individual environment that influenced the options students had or the attitudes they adopted. Many viewed collaboration as prohibited or unlikely due to the way students were pitted against each other or scared of working together. Some saw the tutoring center as the only option because of the way the instructor promoted it, and some were too intimidated to approach the instructor because the large university setting made them seem distant, either too busy or too smart for "small" student questions. As a result of their experiences and the setting, many students developed and implemented a series of steps for who to ask for assistance. Despite the restrictive environment, many students did prefer working as a team with people they could support in return, which was explained with our mutually beneficial relationship factor. While the competitive circumstances were prevalent at this institution, we do not have a way to separate the individual components that make up this university's environment and culture. Many aspects could have contributed to the factors we uncovered, such as the large student body or that the university is research-intensive (for more information about the context, see Section 3.2). In comparison, Knox's work focused on smaller cohorts and found some similar and some different social help-seeking methods, suggesting that class size might also play a role in the environmental influences [20].

Lastly, prior experience had a larger influence on students than originally expected. One possible explanation is that computing courses are not widely available in primary and secondary education in the United States and the field of CS still comes across as relatively new, so the leap to start

learning how to code appears more intimidating. This is exacerbated when classmates appear to have prior experience or effortlessly pick up the new skill.

5.2 Limitations

Our analysis posed some internal validity limitations. Due to the nature of qualitative analysis, which is inherently connected to human interpretation and subjectivity, we aimed to be as transparent as possible about the background of the researchers involved in this study and provide illustrative examples from the interviews that represent the dataset accurately. Despite our efforts, this results in some limitations. The informants' responses could have been affected by how the participants perceived the interviewer. Participants might have been hesitant to share negative reviews about the class or overstate their concern for classroom policy if they had the notion that the researcher was connected to the university or instructor, regardless of explicitly stating otherwise. Regarding the analysis, the researchers' personal experience with social help-seeking in previous classes at different institutions, both introductory programming and others, would have shaped their interpretation of the data.

Our study also has several external validity concerns. The study was conducted remotely during the COVID-19 pandemic, which could have altered recruitment success. Participants needed a computer with a working microphone, access to Zoom, and a stable internet connection, which might have been difficult for some to access. Additionally, this was an incredibly stressful time for many people, so having the mental capacity and time available to volunteer for a study further limited participation. We tried to minimize the negative effect of the pandemic on our results by providing compensation for participation, using a fairly common web conferencing service, and selecting a recent class that was mostly completed before remote learning was implemented. Furthermore, we acknowledge that the sample of students that participated in this study might have been more eager to share their experiences from the class, whether positive or negative, which might have skewed the data we obtained. In addition, ensuring an equally diverse sample of participants was challenging in a field that currently suffers from a lack of diversity, so some perspectives may be missing from our data. Despite that, the gender ratio of our sample had twice as many women and half as many men when compared to the school of computer science and engineering student body at the selected institution, which might have skewed the results to not accurately represent the student body and amplified the negative effects of the competitive structure on social help-seeking behavior.

5.3 Future Work

Future work should consider the limitations of our study and continue the exploratory process of understanding what affects social help-seeking behavior in CS classes. The insight that there appear to be two distinct steps in the process of social help-seeking could also be further investigated. Untangling and exploring those two decision points, the choice to seek help and then from whom to seek it, and the ways to support students at each junction would lead to a deeper understanding of the social help-seeking process and the factors that influence students' behavior.

Furthermore, our results provide a guide for future investigation of possible help-seeking interventions. There are various factors that we described that could be altered to better promote collaboration among students. Elements related to classroom culture could be directly changed by instructors and systematically examined, such as policies that enforce competition and a "weed out" culture or scare students away from helpful collaboration. More internal factors could be addressed by intentionally trying to make students feel more welcome and accepted. For example, creating spaces where students can get to know other students could make them more comfortable by increasing familiarity between students, lowering the fear of judgment, and providing another

source of help that might be more convenient or better fit their needs. It is valuable to verify if theoretical changes lead to promising outcomes in practice. Designing instrumental interventions that minimize the barriers to social help-seeking would allow us to discern if this approach would create a more welcoming environment in the field of CS.

Prior work on social help-seeking found that racial, ethnic, and gender <u>identity</u> can be a significant influence. While our study saw glimpses of this result as well, especially seen from the <u>identity</u> factor, our study was not designed to explicitly characterize these differences. A future study focusing solely on racial, gender, or other identity-based deterrents to social help-seeking in CS could be compelling. As a field that lacks diversity, this element is an important deterrent to understand at a deeper level.

Finally, while we chose to focus on a highly competitive university environment, running this study at other locations to see if our factors translate would lead to useful comparisons. Locations that significantly differ from ours could include smaller colleges, programs with non-competitive majors, or institutions in different locations.

5.4 Conclusion

This research focused on what factors influenced how introductory programming students in a highly competitive university environment engaged in social help-seeking by conducting semi-structured interviews, followed by thematic analysis and qualitative coding on the ensuing transcripts. Our work has laid down the foundation by beginning the process of understanding why students make certain decisions when learning how to code in this context, where the barriers of social help-seeking lie, and where efforts should be directed. While learning introductory programming is not fundamentally different from other learning processes with regard to social help-seeking, taking the subject and environmental context into consideration will lead to better individualized support for students. If we continue investigating the multi-step decision-making process and explore interventions that remove the social, cultural, institutional, and policy deterrents to social help-seeking and support students at each step in their journey, we may be able to broaden participation in computing and improve learning for all students.

REFERENCES

[1] Vincent Aleven and Kenneth R. Koedinger. 2000. Limitations of student control: Do students know when they need help? In *Intelligent Tutoring Systems*, Gilles Gauthier, Claude Frasson, and Kurt VanLehn (Eds.). Springer, Berlin, 292–303.

[2] Susan Bergin, Ronan Reilly, and Desmond Traynor. 2005. Examining the role of self-regulated learning on introductory programming performance. In *Proceedings of the 2005 International Workshop on Computing Education Research (ICER '05)*. ACM Press, Seattle, WA, 81–86. https://doi.org/10.1145/1089786.1089794

[3] Karen Brennan. 2013. *Best of Both Worlds: Issues of Structure and Agency in Computational Creation, In and Out of School.* Doctoral dissertation. Massachusetts Institute of Technology. http://web.media.mit.edu/kbrennan/files/dissertation/Brennan_Dissertation.pdf

[4] Ruth Butler. 1998. Determinants of help seeking: Relations between perceived reasons for classroom help-avoidance and help-seeking behaviors in an experimental context. *Journal of Educational Psychology* 90, 4 (1998), 630–643. https://doi.org/10.1037/0022-0663.90.4.630

[5] Jessica McCrory Calarco. 2011. "I need help!" social class and children's help-seeking in elementary school. *American Sociological Review* 76, 6 (Dec. 2011), 862–882. https://doi.org/10.1177/0003122411427177

[6] Jessica McCrory Calarco. 2014. Coached for the classroom: Parents' cultural transmission and children's reproduction of educational inequalities. *American Sociological Review* 79, 5 (Oct. 2014), 1015–1037. https://doi.org/10.1177/0003122414546931

[7] Adam S. Carter and Christopher D. Hundhausen. 2016. With a little help from my friends: An empirical study of the interplay of students' social activities, programming activities, and course success. In *Proceedings of the 2016 ACM Conference on International Computing Education Research (ICER '16)*. Association for Computing Machinery, Melbourne, VIC, Australia, 201–209. https://doi.org/10.1145/2960310.2960322

[8] Andrew J. Elliot and Harry T. Reis. 2003. Attachment and exploration in adulthood. *Journal of Personality and Social Psychology* 85, 2 (2003), 317–331. https://doi.org/10.1037/0022-3514.85.2.317

[9] Katrina Falkner, Rebecca Vivian, and Nickolas J. G. Falkner. 2014. Identifying computer science self-regulated learning strategies. In *Proceedings of the 2014 Conference on Innovation & Technology in Computer Science Education (ITiCSE '14)*. Association for Computing Machinery, Uppsala, Sweden, 291–296. https://doi.org/10.1145/2591708.2591715

[10] Sally A. Fincher and Anthony V. Robins (Eds.). 2019. *The Cambridge Handbook of Computing Education Research*. Cambridge University Press, Cambridge. https://doi.org/10.1017/9781108654555

[11] Perry R. Fittrer. 2016. *Academic Help Seeking Constructs and Group Differences: An Examination of First-year University Students*. Ph.D. Dissertation. University of Nevada, Reno. https://scholarworks.unr.edu//handle/11714/2140 Accepted: 2017-10-23T18:32:10Z.

[12] Clifford Geertz. 1973. Thick description: Towards an interpretive theory of culture. In *The Interpretation of Cultures*, Clifford Geertz (Ed.). Basic Books, New York, NY.

[13] David Hammer and Leema K. Berland. 2014. Confusing claims for data: A critique of common practices for presenting qualitative research on learning. *Journal of the Learning Sciences* 23, 1 (2014), 37–46. https://doi.org/10.1080/10508406.2013.802652

[14] Qiang Hao, Brad Barnes, Robert Maribe Branch, and Ewan Wright. 2017. Predicting computer science students' online help-seeking tendencies. *Knowledge Management & E-Learning: An International Journal* 9, 1 (March 2017), 19–32. https://doi.org/10.34105/j.kmel.2017.09.002

[15] Qiang Hao, Ewan Wright, Brad Barnes, and Robert Maribe Branch. 2016. What are the most important predictors of computer science students' online help-seeking behaviors? *Computers in Human Behavior* 62 (Sept. 2016), 467–474. https://doi.org/10.1016/j.chb.2016.04.016

[16] Iris Howley and Carolyn Penstein Rosé. 2018. Empirical evidence for evaluation anxiety and expectancy-value theory for help sources. In *Proceedings of the International Conference of the Learning Sciences (ICLS '18)*, 8.

[17] David W. Johnson and Roger T. Johnson. 2009. An educational psychology success story: Social interdependence theory and cooperative learning. *Educational Researcher* 38, 5 (June 2009), 365–379. https://doi.org/10.3102/0013189X09339057

[18] Stuart A. Karabenick. 2001. *Seeking Help in Large College Classes: Who, Why, and from Whom?* Technical Report. Eastern Michigan University. 21 pages.

[19] Stuart A. Karabenick. 2004. Perceived achievement goal structure and college student help seeking. *Journal of Educational Psychology* 96, 3 (2004), 569–581. https://doi.org/10.1037/0022-0663.96.3.569

[20] Daniel Knox. 2017. *A Cartography of Practice*. Ph.D. Dissertation. University of Kent. https://kar.kent.ac.uk/66350/

[21] Amy J. Ko, Robert DeLine, and Gina Venolia. 2007. Information needs in collocated software development teams. In *Proceedings of the 29th International Conference on Software Engineering (ICSE '07)*. IEEE Computer Society, 344–353. https://doi.org/10.1109/ICSE.2007.45

[22] Selma Koc and Xiongyi Liu. 2016. An investigation of graduate students' help-seeking experiences, preferences and attitudes in online learning. *Turkish Online Journal of Educational Technology* 15, 3 (2016), 12.

[23] Marjan Laal and Seyed Mohammad Ghodsi. 2012. Benefits of collaborative learning. *Procedia - Social and Behavioral Sciences* 31 (2012), 486–490. https://doi.org/10.1016/j.sbspro.2011.12.091

[24] Kara Makara and Stuart Karabenick. 2013. Characterizing sources of academic help in the age of expanding education technology: A new conceptual framework. In *Advances in Help-seeking Research and Applications: The Role of Emerging Technologies*. IAP Information Age Publishing, Charlotte, NC, 37–72.

[25] Samiha Marwan, Anay Dombe, and Thomas W. Price. 2020. Unproductive help-seeking in programming: What it is and how to address it. In *Proceedings of the 2020 ACM Conference on Innovation and Technology in Computer Science Education (ITiCSE '20)*. Association for Computing Machinery, Trondheim, Norway, 54–60. https://doi.org/10.1145/3341525.3387394

[26] Robert McCartney, Anna Eckerdal, Jan Erik Mostrom, Kate Sanders, and Carol Zander. 2007. Successful students' strategies for getting unstuck. In *Proceedings of the 12th Annual SIGCSE Conference on Innovation and Technology in Computer Science Education (ITiCSE '07)*. Association for Computing Machinery, Dundee, Scotland, 156–160. https://doi.org/10.1145/1268784.1268831

[27] Silvia Muller, Monica Babes-Vroman, Mary Emenike, and Thu D. Nguyen. 2020. Exploring novice programmers' homework practices: Initial observations of information seeking behaviors. In *Proceedings of the 51st ACM Technical Symposium on Computer Science Education*. ACM, 333–339. https://doi.org/10.1145/3328778.3366885

[28] Laurie Murphy, Sue Fitzgerald, Brian Hanks, and René McCauley. 2010. Pair debugging: A transactive discourse analysis. In *Proceedings of the 6th International Workshop on Computing Education Research (ICER '10)*. ACM Press, 51. https://doi.org/10.1145/1839594.1839604

[29] Sharon Nelson-Le Gall. 1981. Help-seeking: An understudied problem-solving skill in children. *Developmental Review* 1, 3 (Sept. 1981), 224–246. https://doi.org/10.1016/0273-2297(81)90019-8

[30] Sharon Nelson-Le Gall. 1985. Help-seeking behavior in learning. *Review of Research in Education* 12 (1985), 55. https://doi.org/10.2307/1167146

[31] Richard S. Newman. 1994. Adaptive help seeking: A strategy of self-regulated learning. In *Self-Regulation of Learning and Performance: Issues and Educational Applications*. Lawrence Erlbaum Associates, Inc., Mahwah, NJ, 283–301. https://psycnet.apa.org/record/1994-97658-011

[32] Richard S. Newman. 1998. Adaptive help seeking: A role of social interaction in self-regulated learning. In *Strategic Help Seeking: Implications for Learning and Teaching*. Lawrence Erlbaum Associates Publishers, Mahwah, NJ, 13–37.

[33] Richard S. Newman. 2002. How self-regulated learners cope with academic difficulty: The role of adaptive help seeking. *Theory Into Practice* 41, 2 (2002), 132–138. https://www.jstor.org/stable/1477465

[34] Richard S. Newman and Mahna T. Schwager. 1995. Students' help seeking during problem solving: Effects of grade, goal, and prior achievement. *American Educational Research Journal* 32, 2 (June 1995), 352–376. https://doi.org/10.3102/00028312032002352

[35] An Nguyen and Colleen M. Lewis. 2020. Competitive enrollment policies in computing departments negatively predict first-year students' sense of belonging, self-efficacy, and perception of department. In *Proceedings of the 51st ACM Technical Symposium on Computer Science Education (SIGCSE '20)*. Association for Computing Machinery, New York, NY, 685–691. https://doi.org/10.1145/3328778.3366805

[36] Lori Postner and Reed Stevens. 2005. What resources do cs1 students use and how do they use them? *Computer Science Education* 15, 3 (Sept. 2005), 165–182. https://doi.org/10.1080/08993400500224252

[37] Thomas W. Price, Zhongxiu Liu, Veronica Cateté, and Tiffany Barnes. 2017. Factors influencing students' help-seeking behavior while programming with human and computer tutors. In *Proceedings of the 2017 ACM Conference on International Computing Education Research (ICER '17)*. ACM, 127–135. https://doi.org/10.1145/3105726.3106179

[38] Jeremy Roschelle and Stephanie D. Teasley. 1995. The construction of shared knowledge in collaborative problem solving. In *Computer Supported Collaborative Learning*, Claire O'Malley (Ed.). Springer, Berlin, 69–97. https://doi.org/10.1007/978-3-642-85098-1_5

[39] Adam Rosenstein, Aishma Raghu, and Leo Porter. 2020. Identifying the prevalence of the impostor phenomenon among computer science students. In *Proceedings of the 51st ACM Technical Symposium on Computer Science Education*. ACM, 30–36. https://doi.org/10.1145/3328778.3366815

[40] Peggy Roussel, Andrew J. Elliot, and Roger Feltman. 2011. The influence of achievement goals and social goals on help-seeking from peers in an academic context. *Learning and Instruction* 21, 3 (June 2011), 394–402. https://doi.org/10.1016/j.learninstruc.2010.05.003

[41] Allison M. Ryan and Paul R. Pintrich. 1997. "Should I ask for help?" The role of motivation and attitudes in adolescents' help seeking in math class. *Journal of Educational Psychology* 89, 2 (1997), 329–341. https://doi.org/10.1037//0022-0663.89.2.329

[42] Allison M. Ryan, Paul R. Pintrich, and Carol Midgley. 2001. Avoiding seeking help in the classroom: Who and why? *Educational Psychology Review* 13, 2 (2001), 93–114. https://doi.org/10.1023/A:1009013420053

[43] Allison M. Ryan, S. Serena Shim, Shawn A. Lampkins-uThando, Sarah M. Kiefer, and Geneene N. Thompson. 2009. Do gender differences in help avoidance vary by ethnicity? An examination of african american and European American students during early adolescence. *Developmental Psychology* 45, 4 (July 2009), 1152–1163. https://doi.org/10.1037/a0013916

[44] Bram E. Vaessen, Frans J. Prins, and Johan Jeuring. 2014. University students' achievement goals and help-seeking strategies in an intelligent tutoring system. *Computers & Education* 72 (March 2014), 196–208. https://doi.org/10.1016/j.compedu.2013.11.001

[45] Hans Van der Meij. 1988. Constraints on question asking in classrooms. *Journal of Educational Psychology* 80, 3 (1988), 401–405. https://doi.org/10.1037/0022-0663.80.3.401

[46] Tammy VanDeGrift. 2004. Coupling pair programming and writing: Learning about students' perceptions and processes. In *Proceedings of the 35th SIGCSE technical symposium on Computer science education (SIGCSE '04)*. ACM Press, 2. https://doi.org/10.1145/971300.971306

[47] Simon Veenman, Eddie Denessen, Anneriet van den Akker, and Janine van der Rijt. 2005. Effects of a cooperative learning program on the elaborations of students during help seeking and help giving. *American Educational Research Journal* 42, 1 (Jan. 2005), 115–151. https://doi.org/10.3102/00028312042001115