

Characterizing Computing Students' Academic Help-seeking Behavior

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ABSTRACT

Academic help-seeking is a vital part of students' self-regulated learning strategies. Computing students' help-seeking horizon has seen several transformations in the past 15 years such that existing frameworks no longer capture current computing students' learning environment, motivating a dedicated study on computing students' academic help-seeking behavior. Building on extant works that focus on a single course or help source, my research investigates computing students' academic help-seeking behavior across different contexts. By analyzing students' help-seeking records, my research seeks to understand *how* and *why* computing students transition between available help resources while seeking help, as well as how this process changes in different contexts.

CCS CONCEPTS

• **Social and professional topics** → **Computing education; Computer science education; Applied computing** → *Interactive learning environments.*

KEYWORDS

Academic help-seeking

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1 MOTIVATION

Academic help-seeking is a vital part of students' self-regulated learning strategies [9] and is beneficial to students' academic achievement [4]. Students' academic help-seeking behavior has been studied for many decades in the general post-secondary context [12], mostly from the educational psychology perspective with a focus on the social aspect of help-seeking. However, computing students' help-seeking horizon has seen several transformations in the past 15 years: (1) the booming growth of enrollment and class sizes in computing fields has mandated the adoption of educational technology (e.g., office hour queueing apps, online class forums, and autograders embedded on grading platforms), enabling fine-grained

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data collection; (2) an increasing number of large-scale computing classes now heavily rely on undergraduate teaching assistants (UTAs) [14] to provide help, which is not well-captured by the traditional *formal vs. informal* dichotomy of help sources [12]; (3) the covid-19 global pandemic necessitated remote help-seeking, lowering the time/space barriers for students to seek synchronous help; (4) autograders (and recently, large language models) are now incorporated into computing classes' ecosystems, providing students accessible alternatives to obtain constructive feedback that otherwise might need to come from social interaction.

As a result, past findings no longer capture current computing students' learning environment, motivating a dedicated study on computing students' academic help-seeking behavior. Building on recent works that mostly focus on a single course, a single help source/platform, or a single snapshot in students' learning paths, my research seeks to investigate computing students' academic help-seeking behavior with cross-(course)-context, cross-platform, and longitudinal studies. By understanding *how* and *why* computing students seek help in different contexts, these studies can help inform better resource integration/allocation in large-scale computing classes and curriculums to support computing students' learning.

2 BACKGROUND AND LITERATURE REVIEW

Academic help-seeking. Academic help-seeking is a metacognitive behavior grounded in self-regulated learning [4, 9, 11, 12]. Karabenick and Dembo [9] outlined eight (not necessarily sequential) stages of the help-seeking process: (1) determine whether there is a problem; (2) determine whether help is needed; (3) decide whether to seek help; (4) decide on the type of help; (5) decide on whom to ask; (6) solicit help; (7) obtain help; and (8) process the help received. By studying students' help-seeking behavior across all platforms, my research mainly focuses on using observational evidences of stages (3)-(5) to understand the entire process, as well as investigating how this process is learned, shaped, and refined in different stages of students' academic journeys.

Type of help resources. Makara and Karabenick [12] proposed a four-dimensional framework to describe students' perceptions of help resources: (1) *role* capturing formal vs. informal resources; (2) *relationship* capturing the mental closeness students *perceive* toward the help resource, from extremely personal (close friends) to unhuman (textbooks); (3) *channel* distinguishing whether the help resource is over a media (textbooks or video) or from a person; and (4) *adaptability* measuring the help resource's capability to provide personalized help. Most of existing works focus on the *role* dichotomy that separates help given by instructors and classmates, with only formal help being found significantly correlated with

students' achievement [4]. However, UTAs are not entirely formal nor entirely informal, and few studies were able to quantify the efficacy of UTA help in computing classes.

Studies on computing students' help-seeking behavior. The adoption of class forums [2, 16] and office hours queue management applications [15, 18] enabled data-driven studies on computing students' social help-seeking behavior. Existing works on these help resources reported benchmark statistics such as wait time, interaction length, and number of visits per student in their office hours [1, 6, 7, 10], the time (in the semester) students seek help in class forums [5], while also categorizing the kind of help students seek in office hours [7, 10, 17, 19] and class forums [13, 22]. Other works investigated the relationship between identities and help-seeking behavior [6, 20, 21, 24], with the only consistent finding being that female students are more likely (and frequently) to seek help than male. Relatively few works looked into multiple help resources at a time to understand the relationship between students' usage of class forums vs. office hours [13] and usage of autograders vs. office hours [1]. Two studies [3, 23] analyzed engineering/computing students' self-reported usage frequency and perceived usefulness of all available help resources in small-scale classes, revealing a usage progression from easily accessible (but low utility) resources to less accessible (but high utility) resources.

Limitations of existing works. Most of the existing works suffer from the following limitations:

- (1) Focus on an entire class cohort as a whole without investigating potential differences among individual students, and therefore are unable to identify various "types" of different help-seeking behavior;
- (2) Focus on a single platform (e.g., office hours or class forum) without taking into account how students consciously utilize multiple resources simultaneously or *transition* between resources of different modalities (social vs. non-social, asynchronous vs. synchronous);
- (3) Focus on a single snapshot of students' help-seeking behavior (i.e., in a single course at a specific stage in the students' pathway), and therefore do not shed light on how students acquire and refine their help-seeking approaches, as well as whether/how they adapt in different course contexts.

These issues motivate the research questions in Section 3.

3 KEY RESEARCH QUESTIONS

My research aims to tackle the following key research questions:

- **Individual differences.** What are the individual differences in (1) the *kind of help* students seek from each help resource, (2) the help resources they consciously use/not use, and (3) the order of usage of help resources among the used ones? Can we identify personas or types of students? What external factors influence students' individual differences in their help-seeking?
- **Multi-resource behavioral patterns.** How do students' usage rate/frequency¹ of one or more specific help resource(s) impact their usage rate/frequency of other help resource(s)?

¹Usage rate refers to how likely a student uses a particular resource at all, while usage frequency refers to how often a student uses a resource.

How do students use one or more specific help resource(s) immediately before, during, or immediately after using other help resource(s)? How do availability of a specific help resource influence students' usage of another? How does the kind of help needed influence students' decision process on what resource(s) to seek help from?

- **Different Contexts.** How, if at all, do students' *help-seeking characteristics* (e.g., usage rate/frequency of each resource, preference of resource, and ordering of resource) and *kind of help needed* change across different contexts, such as introductory vs. advanced courses or programming-based vs. non-programming-based courses?
- **Longitudinal studies.** How, if at all, do students' help-seeking characteristics evolve along their experience in the curriculum? Do students' individual differences (i.e., their revealed types) remain consistent throughout their learning paths or change over time, and why? How, if at all, do students' help-seeking behavior in a single course (as aggregated cohorts) change over time, and what factors influence such changes?

Current progress on the first two key research questions is summarized in Section 5.

4 METHODS AND DATA COLLECTION

Most of the data used in my dissertation research is/will be collected at Duke University, a medium-size, research-oriented, private university in south-eastern US that follows the semester system. The current scope of data collection covers 4 out of 6 core courses in the Duke CS curriculum as well as a popular elective.² For most of the course offerings, the following data is/will be collected either passively from learning platforms or actively via student surveys:³

- Records of every office hour interaction, including the timestamps of interaction request, start of interaction, and end of interaction, as well as the (anonymized) identities of the student and the TA/instructor;
- Contents on class forums, including (1) the title and category of each thread, and (2) the text, timestamp, and user identity of each contribution (including thread posts, responses, and comments);
- For autograded programming assignments, the timestamp, score, and feedback of each submission attempt;
- Demographics and identities, including race/ethnicity, gender, major, year, and prior experience;
- Self-reported usage preferences, frequencies, and order of usage of help resources;
- Self-reported *kind of help* needed for each office hour interaction (sometimes categorized by course-specific taxonomy, depending on platform and course context);

To answer the *how* parts of the key research questions, the main research methods include (1) visualizing the distributions of single metrics and the relationships between different metrics to help inform the specifics of subsequent analysis; (2) statistical hypotheses

²The courses include CS1, data structures, discrete math, design and analysis of algorithms, and data science (elective).

³All data, including passive and active parts, is/will be filtered by response to an IRB-approved consent form.

testing on interaction of metrics to identify the (non-)existences and magnitudes of underlying effects; and (3) exploratory data analysis such as clustering (to find emergent types of behavior) and pattern mining (to reveal frequent help-seeking patterns). The insights found by such analysis would then motivate mixed-method studies that use qualitative interviews to answer the *why* parts of the key research questions.

5 CURRENT PROGRESS

5.1 Progress on individual differences

My first work attempted to identify individual differences [10] in office hour interactions in a total of 7 offerings across two courses. These interactions were associated with student-annotated information on the kind of help being sought, using the seven steps [8] and UPIC [19] problem-solving taxonomies. This work found that most students in both courses have a “primary” problem-solving phase in their problem-solving processes that account for a majority of their office hour interactions. As a consequence, the course-level phase distributions of help sought do not well-represent the individual students, and instead more capture the distributions of the different *types* of students.

No demographic/identity variable (race, gender, and prior experience) was found to be significantly correlated with either the students' primary phases or their office hour usage characteristics. However, due to the small sample sizes (numbers of students in each demographic bucket that sought help with a sufficiently high frequency to enable analyzing their primary phases), demographic/identity effects cannot be ruled out and need to be revisited in the future. It was also found that most of the interactions took place within 3 days of their associated assignments' respective deadlines, indicating the findings are limited to students' help-seeking behavior closer to assignment deadlines.

5.2 Progress on multiple help resources

My ongoing work analyzes the office hours, class forums, and autograder records in a total of 9 offerings across two courses. While my analysis revealed substantial positive correlations between students' usage rates of office hours and class forums, neither positive nor negative correlations were found between the usage frequencies even after controlling for whether office hours were available at the time when students used class forums. This implies the two social help resources are neither completely complementary nor completely substitutable for the students. On the other hand, there is a significant positive correlation between students' usage frequencies of social resources (combined) and autograders, with the most natural interpretation being that both correlate with the frequency that students need help and consciously opt to seek help.

By integrating the heterogeneous datasets together, I constructed students' chronological help-seeking event sequences at the level of *assignments*, on which frequent rule mining analysis revealed (1) students keep reusing the same help resource such that the usage of the resource becomes a strong predictor of using the resource again for the same assignment; and (2) social help-seeking attempts often led to measurable progress in the autograders. Furthermore, these sequences reveal an interesting behavior of students choosing to seek asynchronous help on the class forums when synchronous office

hours help was available. This can be observed even on students who otherwise utilized office hours regularly. This phenomenon may imply that students do not simply use office hours whenever available and view class forums as an alternative, and more in-depth studies are necessary to understand *why*, with some potential reasons being social anxiety and space barrier of office hours.

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