My research focuses on understanding how computing students interact with learning environments, with the ultimate goal of **crafting better learning environments for learners throughout computing curricula** as opposed to only in introductory or programming courses. My past and current research works fall under the following two themes:

Characterizing computing students' academic help-seeking approaches and behavior

Academic help-seeking is a metacognitive and self-regulated learning strategy [8, 10] central to students' academic achievement [4]. Existing educational theories on help-seeking suffer from implicitly assuming all help comes from human interactions and explicitly assuming a predefined list of help resources [6], neither of which remains the case in the ever-evolving rich landscape of help resources in the age of AI [9,20]. Building on existing empirical works that mostly focus on a single course context, a single (type of) help resource, or a single snapshot in students' learning paths, my research instead seeks to holistically characterize computing students' help-seeking *approaches* and *behavior* across computing learning contexts, across help resources, and over time in quantitative studies, aiming to inform fairer and more effective designs of help ecosystems in large-scale computing contexts. This line of work has been published at premier computing education research venues including ICER [16,21], SIGCSE TS [15,19,20], ITiCSE [17], and TOCE [18].

My work in SIGCSE TS '25 [20] synthesized factors that influence students' help resource selection, then proposed the concept of the **help resource landscape**, where all factors serve as **dimensions** of the landscape with various levels of importance perceived by the students. Through empirical data across 12 offerings of seven courses at two institutions, I discovered that students collectively perceive the timeliness of help as well as the availability and adaptability of the help resource to be the most important, while factors emphasized in help-seeking research such as the formality and the socialness of the help resource are least valued regarding their help-seeking approaches. My work in TOCE [18] focused on the **sequentiality** in students' help-seeking approaches and behavior in these contexts, in which I observed a **progression of clusters** of help resources where resources in the same clusters are used similarly by students. I found this progression to be explanable by not any single factor but rather the entire help resource landscape.

In constrast to the above works that focused on entire cohorts of students, my papers in SIGCSE TS '23 [15] and ICER '24 [16] identified various **individual differences in students' help-seeking behavior**, in terms of (1) types of help they sought in one-on-one interactions with course staff [15], (2) frequencies of their help-seeking actions [15, 16], and (3) their preferred order of help resource usage [16]. I found the latter two parts of this behavior stay consistent across different course contexts and thus may be treated as part of students' individual help-seeking approaches, while the types of help mostly depended on the course context.

Seeking to explain the individual differences, my works in ITiCSE '25 [17] and ICER '25 [21] investigated **the relationships between student characteristics and their help-seeking approaches and behavior**. I discovered that women and nonbinary students preferred internal (course-affiliated) help resources over external ones more than their men peers, and indeed utilized these resources more frequently [21]; on the other hand, prior experiences relevant to the course context are tied to lower frequencies of help-seeking from internal help resources [17]. I also identified more nuanced insights on how students' race/ethnicity, major, and year/standing are related to their help-seeking in different and sometimes contradicting ways in different computing contexts [21].

Finally, my upcoming work [19] examined longitudinal trends of student help-seeking approaches and behavior in multiple course contexts, seeking to understand how the recent emergence of Generative AI (GenAI) tools impact students' help-seeking in each context. I found increases in students' collective preferences for external resources and decreases in their usage of internal resources in some but not all courses, as well as identified a negative relationship between these two metrics.

Informed by insights revealed from this line of work, I designed an intervention that targets first-year students' help-seeking approaches. By explicitly exposing students to the concept of the help landscape as well as the different characteristics of each help resource, my intervention sets eyes on (1) **empowering first-year students to create effective, individualized help-seeking approaches** as they transition to college, as well as (2) **promoting metacognition and self-regulation** whose benefits extend beyond help-seeking. This intervention is being piloted in a small-scale class context in late 2025, and targets a larger-scale deployment and evaluation in 2026.

Impacts of innovative and flexible course policies in computing classrooms

Computing educators design and implement innovative course policies to support instruction at scale [2], to promote collaborative learning [1], or to combat implicit bias in conventional approaches [3]. These policies form integral parts of students' learning experience and often impact different groups of students differently [11, 13]. Using a range of methodology from experimental quantitative studies to systematic literature reviews, I seek to understand the rich design space of course policies and their impact on instructional fairness in computing classrooms. I am especially interested in studying **policies designed for enhancing learner flexibility**, as they align with my teaching philosophy (see teaching statement) of supporting diverse learners with unique needs and learning processes. This line of ongoing work has been published in SIGCSE TS [12, 14] and ITiCSE Working Group Reports [5], as well as under submission/revision at TOCE.

Taking advantage of a natural experiment happening in a hybrid modality, flipped, just-in-time data science elective course, I evaluated the effectiveness of synchronous peer instruction activities [22] on students' learning outcomes by comparing learning gains achieved by students who attended class in each modality. I then compared data from an offering in which student self-selected their modality for each class at free will *against* a second offering of the same course where students needed explicit permission to attend online. My analyses revealed that students who **attended class in-person *and* engaged in discussion during peer instructions** achieved the highest learning gains under the setting where students had the autonomy in choosing their modalities, but the learning gains were closer to uniform for different groups of students under the stricter policy. This nuanced result demonstrates the impact of course policy design on instructional fairness.

Forming student groups is a critical task in project-based and collaborative learning in computing education [7], but the impact of various existing group formation practices on instructional fairness is still understudied within computing education contexts. I participated in an ITiCSE working group [5] that tackled this gap with a systematic literature review on group formation approaches and their fairness impact in computing education. My exploratory queries helped shape the scope of the systematic literature review, and I individually conducted the screening of 1,600 papers and the data extraction of more than 200 papers. Beyond group formation in mandatory groupwork, my ongoing work seeks to quantitatively investigate how **optional** group work [1], where students can choose to complete formative assessments either individually or collaboratively, impacts students' performance, sense of belonging, and help-seeking behavior in upper-level, non-programming based computing education contexts such as discrete mathematics and algorithm design.

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