Undergraduate Computing Tutors' Perceptions of their Roles, Stressors, and Barriers to Effectiveness

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Abstract

Undergraduate teaching assistants (tutors) are commonly employed in computing courses to help students with programming assignments. Prior research in computing education has reported the benefits of tutoring both for students and for the tutors' own learning. In contrast, recent research that examined actual tutoring sessions has reported that these sessions may be less productive than one might hope, with tutors often just giving students the answers to their problems without trying to teach the underlying concepts. To better understand why tutors may be employing these suboptimal practices, we interviewed ten tutors across early computing courses in higher education to identify their perceived role in these sessions, what stressors and factors influence their ability to perform their job effectively, and what kinds of best practices they learned in their tutor training course. Tutors reported their roles around student learning, gauging student understanding, identifying or providing solutions to students, and providing socioemotional support. They reported their stressors around environmental factors (e.g., number of students waiting to be helped, preparation time, peer-tutor frustrations), internal influences, student behavior, student skill levels, and feeling the need to "read a student's mind." Regarding their tutor training course, Tutors reported learning about interaction guidelines and procedures and question-based problem solving. We conclude by discussing how these results may contribute to the less-effective behaviors seen in prior research and potential ways to improve tutoring in computing courses.

CCS Concepts

• **Social and professional topics → Computing education**.

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1 Introduction

Due to the growth of enrollments in computing courses [5, 13], universities have increasingly turned to hiring undergraduate teaching assistants (tutors) to help students in programming-related courses. Prior work in education has shown that instruction from a capable tutor positively impacts student learning, success in courses, grade point averages, and retention [2, 6, 15]. These results have been seen in computing as well, with studies showing how tutors play an important role in students' learning and course experience [1, 7, 10, 23]. An additional benefit of undergraduate tutors is their scalability alongside class sizes as they come from the same undergraduate population as students in those courses [22].

Although the importance of undergraduate tutors in computing courses has been well-documented [22], findings from more recent research indicate that tutors may not always adhere to best practices during their help sessions with students. Krause-Levy et al. analyzed video recordings of 106 tutoring sessions and found that undesirable teaching practices were common [16]. For example, they found that tutors would sometimes not ask the student to explain their problem and would just directly provide the student with a solution to a bug in their code. Previous studies in computing have examined the challenges faced by tutors including unprepared students, acting on plagiarized work, and tutors' insecurities about

their own knowledge [20, 28]. Our work expands on these existing studies by examining tutors' reported self-expectations and stressors faced during tutoring sessions.

To discover tutors' perceptions of their roles and potential barriers to tutoring effectiveness, we conducted semi-structured interviews with ten tutors at a large public North American university – the same institution of Krause-Levy et al. which found suboptimal tutoring practices. Tutors were employed for either a two-course introduction to programming sequence (CS1 or CS1.5) or a computer organization (CompOrg). We focused our interviews on tutoring sessions where students sought help debugging their programming assignments as these are both the majority of tutoring sessions and are where undesired tutor behaviors were previously observed [16].

Our findings show that tutors mainly view their role in student-tutor interactions as "debugging instructors" where they are in charge of helping students learn how to debug. Additionally, they view themselves as guides to the answers, helpers to get students unstuck on programming assignments, and referrers to connect students with external resources. They reported that the main stressors and barriers that influence their ability to carry out effective tutoring sessions included help queue lengths, session preparation time, difficulty of problems that students asked, difficult student behaviors, and relying on other tutors to implement best practices. Lastly, they reported learning in their tutor training courses to deal with a variety of students as well as to guide students rather than providing answers. Although what we heard from these tutors is mostly aligned with them employing good instructional strategies, the stressors they report may be contributing to the behaviors described in Krause-Levy et al. [16].

2 Background and Related Work

2.1 Undergraduate Tutors in Computing

Undergraduate Teaching Assistants, tutors, are widely used to aid instructors in computing courses at many institutions [22]. A literature review by Mirza et al. highlights prior research on undergraduate computing tutors and summarizes their benefits [22]. For instance, tutors were able to offer individualized feedback and tailored guidance to students in both large and small classes [9, 24, 25]. The presence of tutors has also been found to contribute to improved student performance [10, 23] and student satisfaction [8, 21]. In addition, students and course staff have reported that they find tutors to be more approachable for students than instructors [8, 9, 25, 30, 33].

Despite these reported benefits, a recent study by Krause-Levy et al. found that tutoring interactions may not always be as effective in practice [16]. Their study examined the behaviors of students and tutors in 106 video recordings of tutoring sessions. Their findings revealed suboptimal behaviors such as tutors frequently giving students the solution to their problem without teaching them the process of debugging, tutors only asking guiding questions in about one-third of the interactions, and tutors actively interrupting students while they speak in about one-fourth of the interactions.

Our work was inspired by the problems that Krause-Levy et al. revealed [16]. Specifically, we wanted to know what may be causing tutors to engage in these undesirable behaviors. As such, we aim to gather tutors' perspectives via a set of semi-structured interviews.

2.2 Challenges Faced by Computing Tutors

Prior work has identified challenges faced by tutors. One challenge is the peer relationship, specifically that tutors may be perceiving students as friends (or in some cases may actually be their friends) which, in turn, makes the role of a tutor more challenging and creates a conflict of interest [27]. Prior work has also reported that tutors may not be properly trained for their role [7, 26, 29]. In response to these challenges, there have been efforts to support tutors by offering tutor training courses [4, 11, 12, 19, 31, 32].

Markel and Guo investigated these challenges by reporting the first-hand experience of a single tutor in a computing course, identifying several challenges that a tutor may face. Some of these include teaching vs. bug-fixing, inferring student thinking, and not receiving meaningful feedback on their teaching [20].

Riese et al. focused on understanding the struggles faced by instructional assistants (including undergraduates) across European universities through reflection essays collected during their training courses [28]. They found that assistants have various challenges, including student-focused challenges (e.g., individual content knowledge, unprepared students), assessments of students (e.g., determining grading criteria for a passing grade, identifying and acting on plagiarized work, and threats to implementing best practices (e.g., time constraints, tutor knowledge insecurity) [28].

Our work extends this growing literature on challenges faced by tutors in computing, expanding on the findings from Markel and Guo [20] and Riese et al. [28] by interviewing tutors to reveal new perspectives such as 1) stressors that hinder implementing effective strategies, 2) what they learned in their training course, and 3) how what they learned may conflict with their reported tutor roles.

3 Study Design

3.1 Research Questions

To understand the perspectives of undergraduate tutors on tutoring sessions, we investigated the following research questions:

- RQ1: What do tutors view as their role during tutoring sessions when students approach them asking for help debugging?
- RQ2: What stressors or influences do tutors report impacting their ability to provide the guidance they would like to students?
- RQ3: What do tutors report learning during their tutor training class about how to approach student debugging sessions?

3.2 Course Contexts

We interviewed undergraduate tutors who were tutoring for an introduction to computing (CS1) course in Python, a higher-level introduction to computing (CS1.5) course in Java, and a computer organization and systems programming course (CompOrg) course in C and ARM at a large research-intensive public university in North America.

In each of these courses, students can receive individual help from tutors by attending tutoring hours held either in person or remotely (via Zoom). To request help, students submit a ticket through an online queuing system developed and maintained by the department. Students in these courses primarily come to tutoring hours for help debugging their weekly programming assignments.

Figure 1: Semi-structured interview protocol

- What is your experience when getting help from tutors?
- What made you want to become a tutor?
- In your experience, what are the main reasons why students come to your tutoring hours?
- When students come to your tutoring hours for help with their programming assignments, how do you view your role in that interaction?
- When you're in a tutoring session, what factors influence your ability to provide students with help?
- What did you learn in your tutor training course about how to approach debugging sessions?
- Lastly, is there anything else you wanted to add or any comments you have about the tutoring program, students, or other aspects of your tutoring experience?

3.3 Data Collection

We recruited participants via announcements to the tutors during Spring 2022 and Fall 2022 terms. We offered participants a $15 gift card for up to a 45-minute interview. All interviews were conducted by the first author via Zoom and followed a semi-structured protocol to give participants the flexibility to elaborate on their responses (see Figure 1). Audio was recorded, transcribed, and anonymized for analysis per our approved university IRB protocol.

3.4 Participant Characteristics

We interviewed a total of 10 tutors for this study: 3 from a CS1 introductory course, 1 from a CS1.5 course, and 6 from a computer organization and systems programming course (CompOrg).

To work as a tutor at our institution, a student must have taken the desired course, and take the tutor training course concurrently during their first term as a tutor. Our training course includes one hour of instruction and five hours of practical work observing experienced tutors per week. Tutors learn how to communicate effectively with students and how to learn from and support others. Critically, this course walks tutors through examples of constructive and non-constructive ways of interacting with students.

In terms of the amount of relevant tutoring experience each tutor had, 4 participants had 1 term of experience, 3 had between 2–4 terms, and 3 had 5+ terms. The gender split was 7 tutors identifying as male and 3 identifying as female. For their undergraduate career progress, 2 tutors were in their 2nd year, 4 tutors were in their 3rd year, and 4 tutors were in their 4th year. 4 tutors self-identified as an underrepresented student in computer science. 8 tutors identified as Asian or Pacific Islander (including South Asian), 1 identified as White, and 1 identified as Hispanic or Latino.

3.5 Qualitative Data Analysis Methodology

We used the qualitative analysis technique of open coding [14] to analyze our data. Open coding allowed us to capture the frequency of tutor viewpoints regarding all three RQs. This process was carried out by the three authors of this paper.

Researchers began the analysis by reading the same three transcripts to gain a high level understanding of the interviews. The three transcripts were chosen due to the spread of tutor opinions.

Table 1: Code frequencies across research questions

RQ	Code	*N* Tutors
Tutor Roles	Student Learning	10
	Gauging Student Understanding	10
	Teaching Methods	9
	Solution Identification and Granting	8
	Guiding Students	7
	Socioemotional	6
Tutor Stressors	Environmental Factors	9
	Internal Influence	7
	Student Behavior	6
	Reading Student's Mind	5
Training Course	Guidelines and Procedures	8
	Question-Based Problem Solving	4

Three researchers then independently extracted quotes from the three transcripts for each of the RQs. After which, the team met to discuss quote inclusion based on relevance to the RQ. Any conflict in quote inclusion was settled by reviewing the context of the quote.

Once a consensus was reached for the quotes, three researchers independently coded each quote related to its RQ. Afterwards, the analysis team met to discuss whether the codes for each quote was correct. Any conflict in coding decision was settled by reviewing the context of the quote. If conflicts persisted, they were solved with the first author's input. Once completed, they created a code book to keep consistency in naming conventions.

The researchers then each encoded three additional transcripts. Each of the three researchers had at least one transcript overlapping with one another. This was in order to have additional meetings to discuss quote inclusion, coding decisions, and to verify consistency of codes. Any new codes outside of the code book were marked and discussed with the entire analysis team. The same conflict resolution process was carried out for these new transcripts across both quote inclusion and coding decision phases.

Once all transcripts were encoded, the entire analysis team performed thematic analysis [3] together to identify commonalities across codes and create categories for each RQ.

4 Results

We present our analysis of how tutors perceive their role in help sessions, what stressors hinder their ability to provide effective tutoring, and what knowledge they retained from the tutor training course. Table 1 shows our categories for our RQs, ordered by frequency. For each category, we provide additional context regarding the type of codes that fell under that category. Quotes are provided for codes where the description may not be sufficient. Quotes from participants use anonymous identifiers T1–T10.

4.1 RQ1: Tutors' Perceived Roles

4.1.1 ***C1 - Student Learning (10/10 tutors).*** Tutors expressed the belief that their role is to help students understand the material. Their methods for verifying this understanding were varied.

Teaching Debugging (8/10 tutors): Tutors felt that their role is to teach students how to debug.

Future Proofing (7/10 tutors): Tutors reported aiming to have students know how to independently tackle similar problems in the future. *"I think learning how to debug is more important, right? You want to make them self-sufficient and independent of tutoring." - T2*

Not Giving Answer (5/10 tutors): Tutors explicitly stated that their role is to not give students the solution.

4.1.2 ***C2 - Gauging Student's Understanding (10/10 tutors)***. Tutors reported they should be able to figure out what the student understands of the material during the interaction.

Asking Student Questions (6/10 tutors): Tutors reported they should ask the student questions. *"I ask them to find what part of their code is most likely to be creating that difference. And we'll go to that code and look through it and read through it. And if we still can't find the issue, then we'll go to GDB or we'll write stuff out or I'll ask them questions about what the code's actually doing." -T5*

Student Explanation (5/10 tutors): Tutors reported one of their roles as asking students to explain their process. *"I always try to start off by asking them to explain what they've done so far." -T4*

4.1.3 ***C3 - Teaching Methods (9/10 tutors)***. Tutors believed they should use class and external resources, or provide test cases.

Reference Resources (6/10 tutors): Tutors reported pointing students to and utilizing class material or external resources. *"I showed them a resource and after I showed them how you can apply to the problem at hand. [...] I like to pull up a notepad, share my screen and type out some code. [...] I don't want to just say, here's the resource that you're looking for, go away now. Because then you're not really telling them what to do with it. I want to show them how you can actually use it." -T7*

Example Inputs (3/10 tutors): Tutors reported giving example inputs to help students debug.

4.1.4 ***C4 - Solution ID and Granting (8/10 tutors)***. Tutors believed that they should identify, affirm, or give solutions.

Bug Identification (5/10 tutors): Tutors believed they should identify the student's bug with the student. *"Ideally if they could figure out the bug during the time I'm there, that's great. [...] Because keep in mind that at least in my perception, these students are coming in with no idea of where to look at even fixing their code. I want to provide them that approach so that one they'll recognize where the error is through debugging and then from there I'll just let them go out their way, "Okay, now we've localized the error to this specific portion of the code. I think you have enough of a starting point to where you can start doing this on your own again." -T10*

Solution Assertion (2/10 tutors): Tutors reported that they should tell the student whether or not the student's solution is the correct solution. *"I help the students learn the debugging process, and then together we come up with the answer and then I have them figure out the answer, and then I then tell them if it's correct or not." -T8*

Give Syntax Answer (2/10 tutors): Tutors reported that their role is to give coding syntax solutions. *"[...] they don't understand what you're saying most of the time. So you have to directly show them like, "Okay, I'm going to indent this for you, right? I'm going to describe why I did that, and then I'm going to have you reiterate to me why that was important." -T2*

Give Coding Answer (1/10 tutors): A tutor reported a role of giving coding solutions. *"For me, sometimes when I don't really know how to help them learn the process, I just straight up tell them, "Oh, okay. Yeah, just do this."" -T3*

4.1.5 ***C5 - Guiding (7/10 tutors)***. Tutors showed a belief that they should guide students through the problem, not necessarily to the answer, but to achieve a certain level of progress.

Guiding Questions (5/10 tutors): Tutors reported asking guiding questions to students to help them progress. *"I usually try to do guiding questions if I'm very familiar with the specific error they have of, I'll ask them something of, "Where do you think this error is happening?"" -T10*

Help Get Unstuck (4/10 tutors): Tutors reported they should help students get unstuck from a bug or misunderstanding.

4.1.6 ***C6 - Socioemotional (6/10 tutors)***. Tutors believed their role was to understand and adapt to a students' emotional state.

Being Approachable (4/10 tutors): Tutors reported that they should be an approachable resource.

Empathy (3/10 tutors): Tutors reported they should be empathetic to the students. *"I hope that they feel that they were welcome during the session that I just had with them. Just to remind them, we're still here, that last push that they need to complete the assignment. So, I just trying to motivate them." -T4*

4.2 RQ2: Stressors and Barriers to Effectiveness

4.2.1 ***C1 - Environmental Factors (9/10 tutors)***. Class structure and the dynamic of the tutor cohort can be a stressor and thus can influence the tutoring quality.

Queue Length (5/10 tutors): Tutors reported long queue lengths as a major stressor.

Prep Time (4/10 tutors): Tutors report short turnarounds for prep before tutoring as a stressor. *"Sometimes the programming assignments get released to the tutors really late. The day to release to students. [...] So I've had to go in blind on two of the assignments now, which makes it really hard to help students with them." -T5.*

Peer Tutor Frustration (3/10 tutors): Tutors report feeling frustrated with other tutors. *"There are a lot of tutors I see that don't go to meetings, they don't log their hours in the queue. That confuses me. And it kind of frustrates me, actually, that someone's talking to them and they just get away with it. [...] if you sign up to be a tutor, then you want to be a tutor, and so why aren't you being a tutor? So I think more accountability in that aspect would be nice, because it's kind of demotivating." -T2.*

4.2.2 ***C2 - Tutor Internal Influence (7/10 tutors)***. We found tutors report internal struggles can lead them to doubt their competency when tutoring.

Tutor Knowledge (5/10 tutors): Tutors report their knowledge of material, or lack thereof, affects their practices. *"if its a bug that I have no comprehension of. [...] I'm as lost as they are or I have some idea but I cannot be sure. That's what I feel influences the quality of my tutoring sessions." -T10.*

In Sync With Lecture (3/10 tutors): Tutors report the stress of being aware of lecture pacing to assure they are not advancing too fast for students.

Tutor Self Pressure (2/10 tutors): Tutors report pressuring selves to answer all questions and issues students bring to sessions. *"I have to think about it myself along with them which I think that reflects in my tutoring of at least my confidence in helping them." -T10*

Pressure to Give Answer (1/10 tutors): A tutor reported feeling constrained to give answer to students.

4.2.3 ***C3 - Student Frustration (6/10 tutors).*** Frustration that emerges from students behavior, their gap in soft/hard skills, and the role of reading students' minds.

Lack of Student Preparation (5/10 tutors): Tutors report frustration towards students not being prepared for tutoring sessions. *"A lot of students don't understand that we can't help you unless we exactly know what your problem is. [...] You ask them, "What have you tried?" They haven't tried anything. [...] If you haven't tried anything, I don't really know how to help you in a way that [...] you'll understand what's going on." -T2.*

Difficult Students (5/10 tutors): Tutors report difficulty working with students who disregards tutors advice or methods. *"Difficult students, like I said, I've dealt with a few, [...] It's like you don't tell them what they want to hear. They get pretty unhappy." -T7.*

Student Wants Answer (3/10 tutors): Tutors report stress from students trying to get the answer in tutoring sessions.

Lack of Student Communication (3/10 tutors): Tutors report frustration towards students not communicating with them. *"Sometimes I feel like the students don't really tell me that... Did I not explain it properly, or is there something else that's still unclear?" -T4.*

Lack of Student Debugging (2/10 tutors): Tutors report frustration of students not attempting to debug before sessions. *"They often are new to debugging and often haven't really debugged on their own prior to coming to me, which normally we require. [...] we sometimes send them back and tell them they have to debug first." -T5.*

Stressed Students (2/10 tutors): Tutors report difficulty from stressed student behavior. *"So I think one big thing is obviously if there's a huge queue I need to cut students off at some point and they can be very unhappy when you do that." -T7.*

Deadline Dependent (2/10 tutors): Tutors report changing their behavior depending on the proximity to the deadline. *"If they're still in the beginning, near the end of the deadline, [...] it makes sense to give them a little bit more help [...] whereas someone comes in at the beginning, you point him at the direction where you think it's most effective for them to learn." -T6.*

4.2.4 ***C4 - Reading Student's Mind (5/10 tutors):*** Tutors report trying to understand a student's thought process or previous knowledge as stressful.

Reading Student Code (2/10 tutors): Tutors report having difficulty understanding student code.

Understanding Student Explanations (1/10 tutors): Tutor reports difficulty in understanding student explanations. *"I can't tell if the student understands, but they're phrasing it in a way that I would never think about it. Or if there is a misconception that's embedded in that explanation [...]. So it usually takes a little while to figure out what they already know and what they don't know." -T10.*

4.3 RQ3: Learning from Tutor Training Course

4.3.1 ***C1 - Guidelines and Procedures (8/10 tutors).*** Tutors reported that they were taught a set of procedures and guidelines for interacting with students. These procedures were taught in order to show how to interact with different types of students and their needs in order to better facilitate productive tutoring hours.

Procedures (6/10 tutors): Tutors report being taught procedures for common scenarios. *"I think the demos were useful. I think procedures, for the most part. The most useful thing that came out of that course, knowing, 'Okay, in this scenario, I should talk to this person first and then talk to this person'" - T2*

Student Variability (4/10 tutors): Tutors reported being prepared to engage with students of varying personalities.

Respectful Interactions (3/10 tutors): Tutors report being instructed to interact with students in a respectful manner. *"The other things I learned are to be respectful. If the student doesn't know something that at least in your mind that you think is something that is simple that they should know, do not let that show" -T10.*

4.3.2 ***C2 - Question Based Problem Solving (4/10 tutors).*** Tutors reported being taught a question based approach in addressing students issues. Through this approach, tutors aim to guide students to the answer instead of telling them the answer directly.

Not Giving Answer (4/10 tutors): Tutors reported being taught not to provide the student with the answer to their question. *"We did see demos of the professor, how you would talk to a student, [...] not giving too much away, making sure they understand it rather than emphasizing the answer." - T2*

Guidance (2/10 tutors): Tutors reported being instructed to guide students. *"The thing about asking them questions instead of just answering their question is so helpful [...] instead of getting an answer spoon fed to them, they relate concepts [...] and connect." - T1*

5 Discussion

We discuss how our findings relate to prior research and how they inform potential improvements for university tutoring programs.

RQ1 - Tutor Roles: We heard encouraging responses from tutors regarding their roles in fostering student learning, guiding students toward solutions, and helping students become unstuck rather than solving problems *for* them (Section 4.1). However, this focus on student learning comes into conflict with the stressors of time constraints and queue lengths found in Section 4.2. With this, we see the consistent theme emphasizing the idea of "future proofing" where students become more independent of tutoring, freeing up the queue—a major tutor stressor. Although future proofing may help student learning, the stress from queue length and time pressure might be leading to the other contradicting major reported tutor role of identifying or granting solutions—a practice likely detrimental to student learning. At least one tutor (T2 in Section 4.1.4) captured the challenge well stating that it is hard when students are very confused to have them find the problem on their own (a stressor found in Section 4.2.3). T2 talked about the importance of explaining the answer when a tutor provides it—possibly a recognition that short debugging-focused tutor help sessions may be insufficient to help students who are truly struggling.

These tradeoffs between providing the solution with an explanation and guiding students to the solution on their own highlight the challenges tutors face and may help explain the findings in Krause-Levy et al. [16]. The finding from the literature review by Mirza et al. [22] that the presence of tutors positively contribute to student performance [10, 23] and student satisfaction [8, 21] may be

explained by one of (or both) these two contrasting reported tutor roles: 1) the emphasis on student learning leave students with more knowledge to perform better and feel satisfied from learning with the tutor, or 2) by identifying or providing students with solutions, students end up with higher scores on their assignments (leading to higher performance) and higher satisfaction due to receiving high scores after getting solutions from tutors.

An interesting finding is that tutors report providing socioemotional support to students as a tutor role—specifically by being empathetic, validating student effort, and being approachable (Section 4.1.6). This may help further explain why students find tutors more approachable than instructors [8, 9, 25, 30, 33]. Although it is intuitive to think that interacting with your peers would be more approachable than an instructor, it is interesting to note that tutors are reporting this as a specific role rather than a byproduct of being the student's peer. Alternatively, this socioemotional role coupled with the stressors of difficult students, student impatience, and students wanting the answer (Section 4.2.3) might also be a motivator towards providing students with answers.

RQ2 - Barriers to Tutoring Effectiveness: One of the most prominent reported tutor stressors is that of environmental factors—specifically queue lengths (Section 4.2.1). Queue length reflects the number of students needing help and one can understand how a long line of students waiting for help can pressure a tutor. Indeed, in the reflections of Markel and Guo [20], they also report the stress created from a long queue. Referring back to Krause-Levy et al. [16], one can imagine the combination of a large number of students waiting to see the tutor, those students being eager to gain help, and the stress of trying to guide students in an effective manner could lead to tutors taking shortcuts.

This seems to be exacerbated by the tutor's internal influences of needing to know all answers to student questions (Section 4.2.2) and—more directly—frustration with other tutors not using best practices (Section 4.2.1). This may be that they believe other tutors are employing unproductive behaviors similar to those from Krause-Levy et al. [16], although the criticism may be unwarranted unless they have first-hand knowledge of other tutors' behaviors.

These reported stressors are also in line with Riese et al. who found tutors facing student-focused challenges (Section 4.2.3), time constraints (Section 4.2.1), and tutor knowledge insecurity (Section 4.2.2) [28]. We also find similar stressors from Markel and Guo, including the need to "read a student's mind" to gauge their understanding (Section 4.2.4).

RQ3 - Tutor Training Course: Based on tutor responses and our own inspection of the tutor training course content, we found that the tutor training course teaches tutors to not give students the answer. In addition, tutors report learning to deal with different types of students during the help sessions in the course (Section 4.3). The course appears to offers general guidance that is relevant to helping students learn—however their reported role of providing solutions (Section 4.1.4) contradict these teachings. Perhaps what is missing is a stronger expectation to not provide answers to students—as well as training students to not expect an answer.

Improving a difficult job. Reflecting on our tutor interviews, it becomes apparent how challenging the task would be for anyone, let alone undergraduates who have just learned the content themselves. Under the pressure of their peers to simply give them the answers and a long queue of potentially impatient students, it is easy to see how a tutor might disregard their training to guide students and instead resort to less effective practices, particularly when they encounter a student who needs more help than a brief "debugging" session can offer. Interestingly, tutors report wanting to teach students, students report wanting to learn [18], but due to several circumstances, best practices are not employed. Future efforts to improve the quality of tutoring sessions may wish to take a more holistic view that seeks to combine training courses with efforts to reduce the stress on tutors, including ways to reduce queue lengths, offer struggling students longer conceptual help sessions, management of tutors to identify those who are struggling in order to provide them with more support, and set expectations with students to expect the solution from help sessions.

Limitations: Roles that tutors reported in our interviews are examples of effective tutoring practices that they were taught in the tutor training course. A potential limitation is that there is a chance they were telling us what they learned in that course; or what they thought we wanted to hear. Although tutors did report several challenges that might lead to unproductive behaviors, these positive reports may be a result of social desirability bias [17]. This seems possible given the disconnect between their reported behaviors and actual behaviors found in a similar study at a similar institution [16], but it is also possible that tutor behaviors are better at this institution or that the tutors who were willing to be interviewed are among those who employ more effective practices. Tutors own reflections on their behaviors could also be misaligned with their actual behaviors. Lastly, our study was conducted at one research-intensive university in North America that offers a tutor training course, so results may not generalize beyond this context.

6 Conclusion

Prior research reported that help sessions with tutors may not be as effective as instructors might hope. We explore potential reasons for this behavior by interviewing tutors about their roles during debugging help sessions with students, stressors and factors that may influence their implementation of best practices, and what they learned in their tutor training course. Tutors reported their role as guides to help students learn, as they were taught in their tutor training course. However, *in contradiction*, some tutors reported their role included providing students with solutions. We found tutors are under multiple pressures, notably long queues of students waiting for help and students asking for help who need more extensive support than a short debugging session can provide. These pressures may contribute to tutors employing undesirable tutoring practices, *particularly under time pressure*. This better understanding of the difficulties faced by tutors can be used to implement changes that could improve the quality of these help sessions for both students and tutors.

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