

# Out Of Class Help In Computer Science: How Can We Make It Better?

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*Abstract –*

Office hours and labs are essential components of higher education providing students with a valuable opportunity to obtain relevant answers and connect with their instructors and peers. However, the challenges of managing these help sessions, particularly in the field of computer science, have become increasingly complex in the face of emerging communication technologies and shifting student behaviors. As online learning continues to grow, traditional methods of conducting office hours and labs struggle to scale to accommodate larger numbers of students. Consequently, it is crucial to develop new approaches to managing these sessions and to encourage student attendance. This research attempts to address the challenges of traditional office hours and labs through the development of the HelpMe system. The system provides a user-friendly interface that enables instructors and teaching assistants to manage student questions. In addition, the research investigates the effectiveness of incentivizing student participation in help sessions and early assignment submission. The initial feedback on the HelpMe system was positive, demonstrating significant approval from both instructors/teaching assistants and students, the HelpMe system resulted in behavior change in students. The incentivization approach has also been found to improve student learning outcomes.

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# 1. Introduction

Office hours, where instructors and students interact, foster the success of college students in many aspects; they increase retention, lead to higher student satisfaction and confidence, and determine student outcomes [1, 2, 3, 4] . Studies have also shown that any form of office hours improves students' interest in the discipline [5] . In the meantime, teaching assistants (TA) are also very important in computer science teaching, boosting student retention rates and resolving student confusions. The cheaper resource of peer mentoring also emerges as a fantastic solution to the expanding enrollment numbers in Computer Science [6].

Office hours and peer mentoring sessions (here by both are referred to as help sessions, and reference to office hours will also include peer mentoring sessions) also help especially in the field of computer science. Computer Science teaching can create uniquely confusing situations for students in assignments when they take hours to debug errors in their code. Such confusion can often be easily resolved through live help sessions [2]. It is widely accepted that both office hours and peer help sessions are especially important in computer science teaching.

However, there are many challenges to providing sufficient interaction and help to students outside of the classroom. Office hours are often underutilized in the context of rapidly growing computer science programs. Nowadays, students often prefer email or other kinds of communication over live help sessions, which might require a commute and cause inconveniences [2]. Many studies highlight the same problem where students have to wait in line for assistance. This is combined with students' prevalent misperception of office hours. Cotten and Wilson cite the common issue where students are unaware of the benefits of professor office hours, misconstrues the purpose of professor office hours, and are uncertain about instructors' reception of their ideas [4]. Many of the same issues such as inconveniences and misconceptions exist in peer mentor sessions.

Overall, the immediate rewards of help sessions for most students, which is obtaining usually short answers, may not be worth the trouble. In the meantime, email and other asynchronous ways of communication outside of classroom in computer science teaching are not good replacements. Firstly, students will be missing out on essential interaction opportunities with peers and instructors outside of the specific questions. Secondly, asynchronous communication such as email can be overwhelming and confusing for instructors both by the numbers and the complexity of email exchanges [7]. Computer science teaching is facing a rapid increase in the student to faculty ratio [8], making email communication with the only instructor even more burdensome. Often, instructors who need to uphold high research standards in their own fields cannot comprehensively respond to the flood of student emails. Such situations are exacerbated by mismatch of TAs and students; students often opt to contact instructors directly rather than TAs whom they are less familiar with. Thirdly, students may not be able to get prompt and effective response through email, web search and other methods. Here, we shall also consider that students tend to leave assignments and studying to the last few hours before due time, at which no office hours are offered. This problem prevents students from using help sessions. Overall, there are no effective replacements for live help sessions.

Help sessions are also potentially fantastic sources to obtain information regarding the courses, as staff can observe student questions and adapt their courses accordingly. Many instructors claim

that office hours are one of the most important channels for feedback of the class [1]. However, both online and in person help sessions cannot accurately capture the valuable interactions between students and staff in the traditional office hour models. Reasonably, instructors can only obtain information through qualitative conversations with students during their own office hours instead of across all help sessions.

In this research, a twofold approach is used to improve student satisfaction for help sessions and encourage students to interact with instructors and teaching assistants in an effort to revitalize help sessions. First, we developed an office hour queue system, HelpMe. This tool improves help sessions by lowering the time cost for users, who require only one extra step to join a help session. Secondly, the course on which the research was conducted employed a novel grading system that provided bonus marks for students who attended help sessions and completed assignments early. This method will be hereby referred to as assignment incentivization. We hypothesize that the HelpMe system and assignment incentivization can change student behaviors through improving help session experience for both students and staff. Thus, this twofold approach should enhance student learning as well. The hypothesis was tested through several research questions.

The research has three main objectives:

1. Develop an office queue system to aid office hours and collect office hour interactions.
2. Examine the effectiveness of an office queue system in resolving the deficiencies of office hours for both students and staff.
3. Use the data collected by the office queue system to examine the practice of providing bonus marks for handing in correct assignments early.

The research aims to answer the following research questions:

- RQ1: What challenges are present in office hours at UBC and what types of questions are being asked?
- RQ2: Does the HelpMe system increase student satisfaction and have a positive effect on office hours?
- RQ3: Does a grade incentive in completing assignments early and attending office hours help CS students in learning?
- RQ4: Does interaction with staff correlate to student performance?
- RQ5: If the HelpMe system and assignment incentives improve student satisfaction and performance, does this change student behavior in seeking out of class help?
- RQ6: Is the HelpMe system a helpful tool for instructors and teaching assistants?

The research was conducted during COSC 404 Database System Implementation, an upper-level computer science course at the University of British Columbia. Quantitative data regarding help session interaction from the HelpMe system and survey questions answered by COSC 404 students were collected. A combination of survey data and quantitative data from HelpMe was used to answer RQ1, RQ3, RQ4, and RQ5. RQ2 was answered with just the survey results regarding questions such as satisfaction with the HelpMe system. An interview with the course professor and TAs provided data for RQ6.

This research has contributed in the following ways. Firstly, we implemented an efficient office hour queue system and tested the efficacy of this system, which revealed new perspectives on help

session technologies. Secondly, we examined the practice of incentivizing students to interact with instructors and handing in assignments early.

The organization of this thesis is as follows. Chapter 2 introduces related works about office hours in higher education. Chapter 3 explains the context and background of the research. Chapter 4 describes the HelpMe system developed for this research. Chapter 5 introduces the methodologies used and data collection channels. Chapter 6 summarizes the findings and performs an analysis of the research questions. Chapter 7 concludes the research and indicates possible future research areas.

## 2. Background

*"Learning is not a spectator sport. Students do not learn much just by sitting in class listening to teachers, memorizing prepackaged assignments, and spitting out answers. They must talk about what they are learning, write about it, relate it to past experiences and apply it to their daily lives. They must make what they learn part of themselves." Chickering, Arthur W. and Ehrmann Stephen C. [18]*

### 2.1 Usage of Office Hours

Office hour help sessions face significant challenges and a struggle to stay relevant to students. Research has shown that students tend to use office hours only for specific questions such as troubleshooting [1]. There is also confusion among students over communication with professors outside of academic settings [2].

In person office hours are becoming outdated in the modern technological context. Smith et al. found that the most common reason of avoiding office hours is inconvenience with students asking questions such as "Is it worth it to commute 30 minutes to ask a 5-minute question?" It also poses problems for commuter and minority students [9, 10]. Many organizations are exploring more effective ways to offer office hours through digital platforms. It has been found that online office hours are more effective. Early virtual office hour research has proven the effectiveness of online office hours. CS50 Queue by Harvard, a very early attempt at virtualization of office hours, showed that there is huge potential in virtual office hours [10]. However, the same research also mentioned that online office hours do not solve all existing problems with office hours. For online office hours, students often claim long wait times, lack of physical interactions and confusion over online queues [10]. Thus, it makes sense that much research still suggest that virtual office hours have many shortcomings despite having better satisfaction than in person ones, citing that email and other tools are still the preferred ways of communication [9]. The bottom line is that while research has shown the advantages of virtualized office hours, mere virtualization of help sessions is not enough.

### 2.2 Improving Office Hours

Many researchers propose to investigate how new technologies would change perspectives of students towards office hours [2]. Some research found that even just using Instant Messaging could effectively increase faculty-student interactions (Lent and Cifuentes). The Digital Hand is a more recent queuing tool developed to collect quantifiable data on student and teaching assistant

interaction. With the data collected, they found several problems with office hours such as high waiting times, and long and unequal distribution of interactions [11].

There are some other queue systems implemented to resolve certain problems with office hours. For example, several professors applauded a Queue system for the effectiveness, data collection, and versatility. In the end, the paper recommended more research on student experience in using queues for office hours [12]. The same group of professors also conducted more research on the queue system and found out that the Queue system is great for not overlooking student questions [12, 13]. In Khoury College of Northeastern University, a queuing system was also developed, although no research has been done on the system. Overall, some institutions have realized that queue systems can be beneficial for office hours due to the flexibility offered, especially for larger computer science classes. However, there is a lack of research on using a queue system to resolve challenges with office hours.

Cotten and Wilson, through their qualitative study, also discovered that students benefit significantly from encouragement of instructors, as instructors may change students' perception of office hours; they can make office hours more approachable. They also cited the fact that office hours intrinsically take significant time for both the instructors and students, so it is very important that office hours are as convenient as possible for everyone [4].

Interactions between students and teaching assistants (TAs) are less studied. Nevertheless, more focus of studies in this area have proven that TA lab sessions in computer science can help students significantly [6].

Incentivization has been shown to be very effective in aiding student learning. Some studies in related fields such as math and statistics prove that bonus marks for mastery of homework correlate with better understanding of class materials [14]. In computer science, gamification methods such as providing Achievement Badges are proven to be effective motivators for students [15, 16]. However, assignment incentivization related to our research on completing assignments early is not well studied.

## **2.3 Instructional Environment**

The research was conducted in COSC 404 Database System Implementation, an upper-level elective computer science course that builds upon on COSC 304 Introductions to Databases. Despite being an elective, COSC 404 had 99 undergraduate students and 8 graduate students. All students are 3<sup>rd</sup> year or above, and the majority of students in the course were computer science majors. There were two TAs who combined had four 2 hour help sessions online through zoom. The professor offered one hybrid office hour session for helping students both in person and online. He also assisted with the online TAs sessions when wait times were longer. The help sessions were spread across the weekdays so that there is a 2-hour help session from 2 to 4 pm on each of the weekdays.

Partly in response to the underutilization of office hours, the class employed innovative practices regarding office hours. There was a 10% boost on assignment grades if students completed the weekly lab assignment correctly and checked them off with TAs or the instructors on or before



Monday’s help session instead of the regular due date on Friday. The boost of grade could also carry over to the overall grade in class. Due to this incentive, there was often an influx of students in the Monday office hour session to obtain the highest bonus possible. Such office hours practice, albeit being helpful to student learning, created unique problems. When many students swarmed into one office hour, TAs/Instructors scrambled to find the next students to help while confused students waited to be called on. These problems prompted the initial idea of developing a queue system for office hour that could make office hours more manageable.

### 3. HelpMe – An Office Hour Queue System

HelpMe was developed based on Khoury College's open-source office hour queue but modified to suit the needs of this research [17]. This section will explain how it works and what it provides for users.

Our main goal for the HelpMe system is to provide the new service for queueing students while making sure the extra step of using the system to enter office hours can be outweighed by the benefits of the system.

The HelpMe system is a tool designed to help students and instructors. The core feature of HelpMe is providing a visual queue system of the next student in line as seen in Figure 1 and Figure 2. On this application, TA and Professors share the same Queue interface that will be referred to as the staff interface while the students only have access to the student interface.

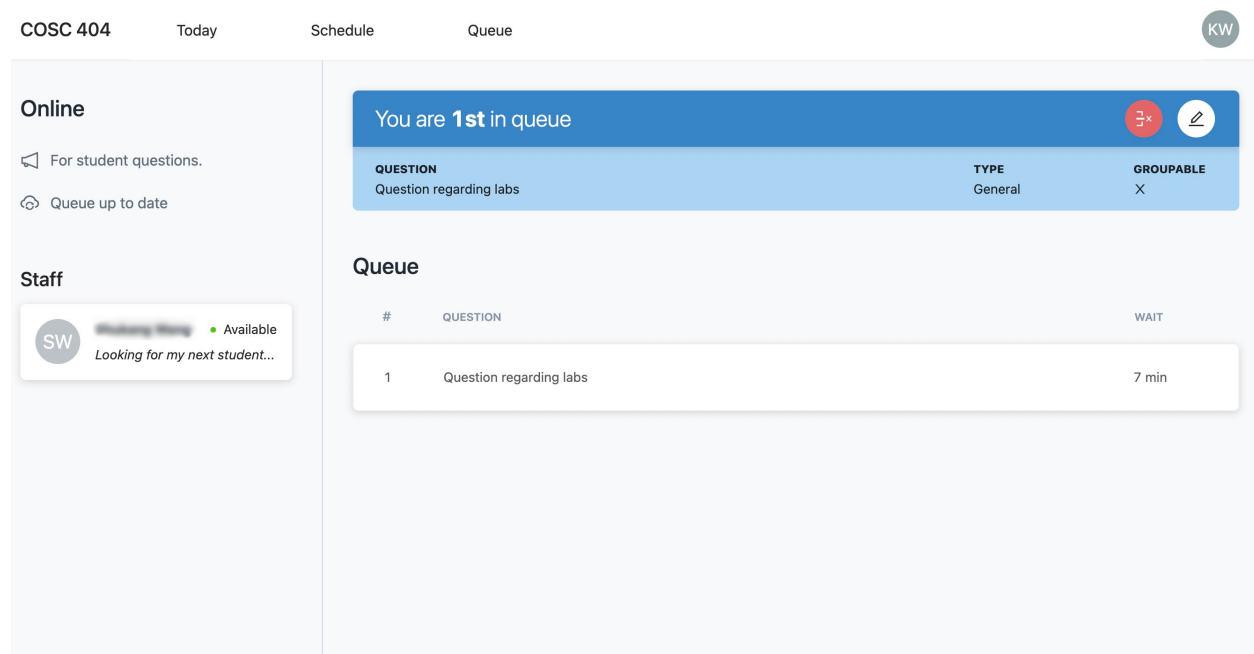


Figure 1. Student View

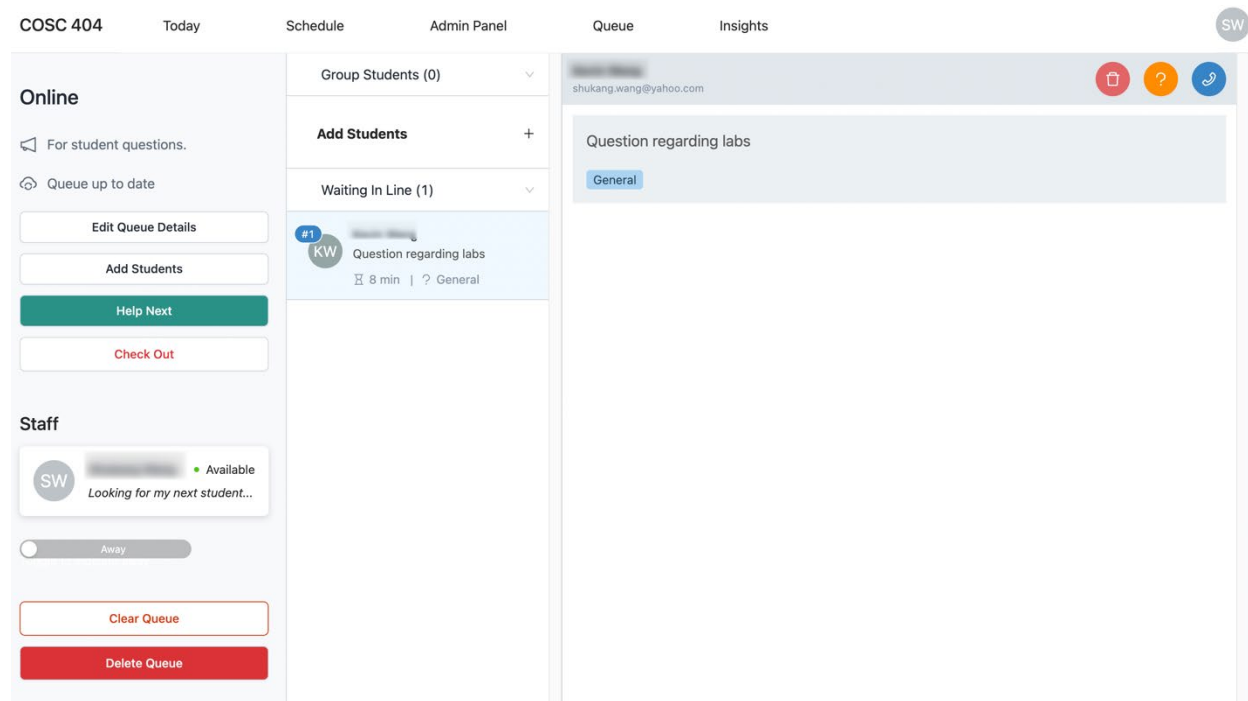


Figure 2. Staff View

The interaction of help sessions can still take place in a traditional office in-person or through Zoom. The process starts with a staff (Instructor or TA) opening a queue on HelpMe and checking in to signify that they can provide help. The staff observes students waiting in line and can choose to help any student by clicking on the student on the middle "Waiting In Line" section seen in Figure 2. The staff starts to help students by first clicking the blue help button for the next student in line. The actual interaction proceeds as the instructor opens a breakout room on Zoom for the student or works with the student in person. After the help session is completed with the student, instructors click the finish helping button and continue to find more students to help.

Students start with joining an active queue through a question form that asks them to provide relative information regarding their question. Afterward they wait while a Staff comes for help signaled by a notification and changed UI in the system. They then proceed to be helped through Zoom or in-person. After the help session is completed with instructors closing the session, the students' interface changes again to Figure 5.

In this process, students can observe their place in line, status of all staff, wait times of all questions, and all general question details. Staff can observe question details, student names and access the administration details.

All users can access the Calendar page (Figure 3) that displays schedules of help sessions. The information on this page is linked to a staff uploaded Google calendar. The calendar is also displayed on the Homepage.

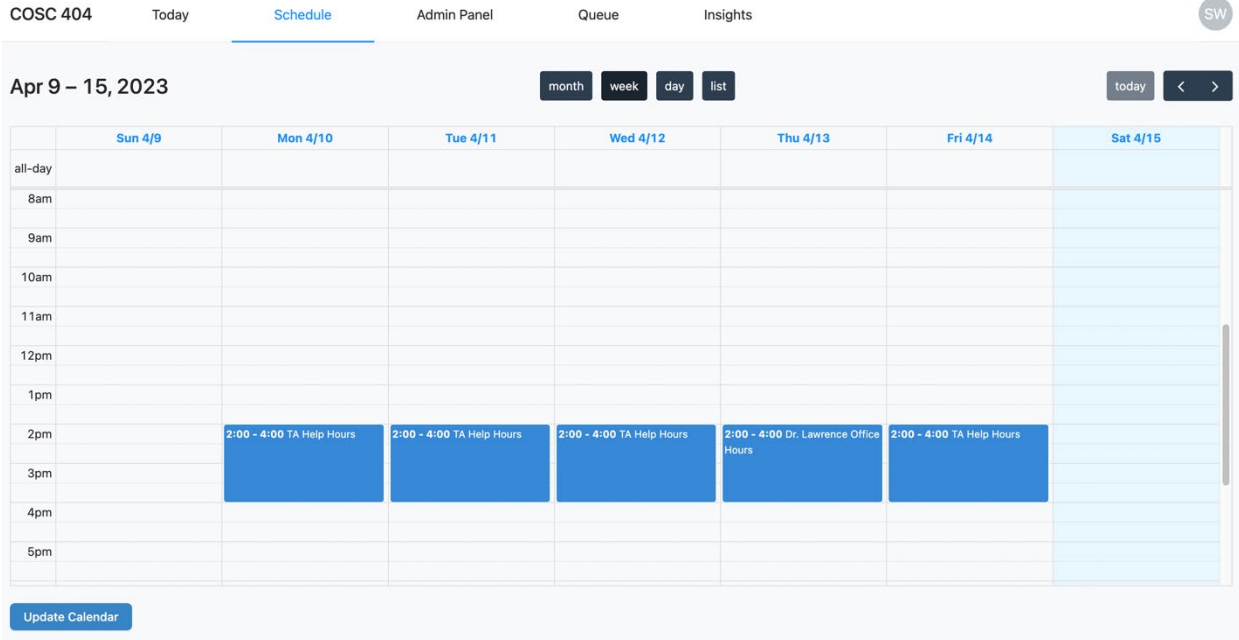


Figure 3. Calendar page

### 3.2 Student view

When there are no current office hours, students cannot do anything in the queue as seen in Figure 4. However, students can observe the office hour calendars on the right-hand side of Figure 4 and the average wait times of each day of the week.

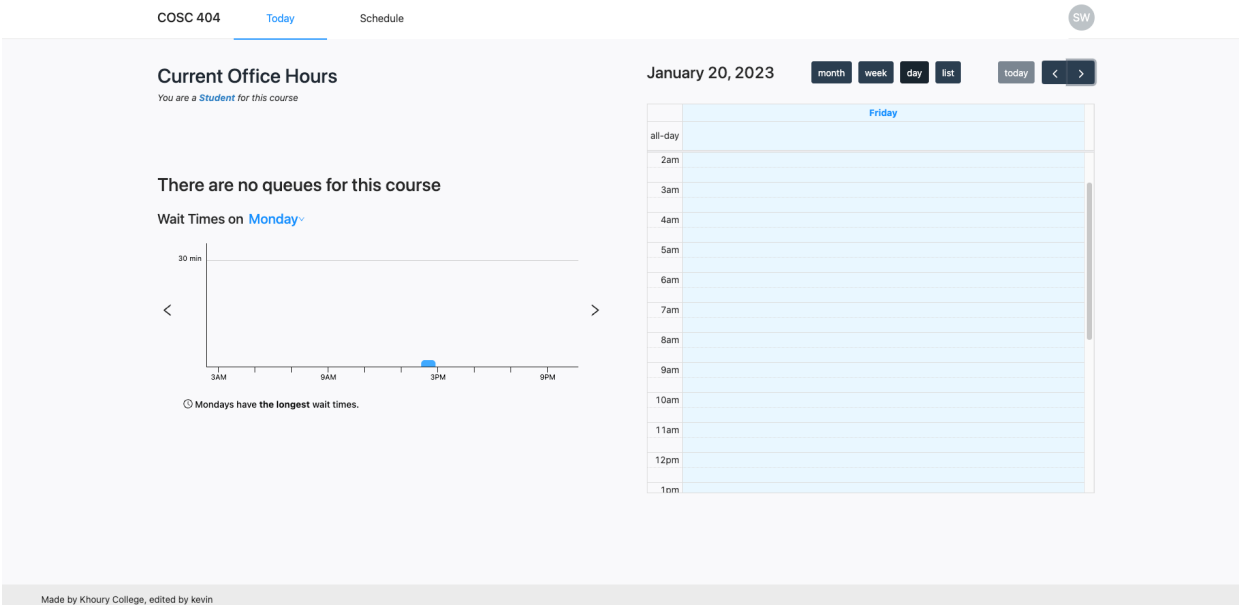


Figure 4. Student Homepage no Queue

As shown in Figure 4, students can open the queue when there are active queues with staff and join the queue through the student form. A student must provide their question time and a description of the question. Location is set to in person, and groupable is set to false by default.

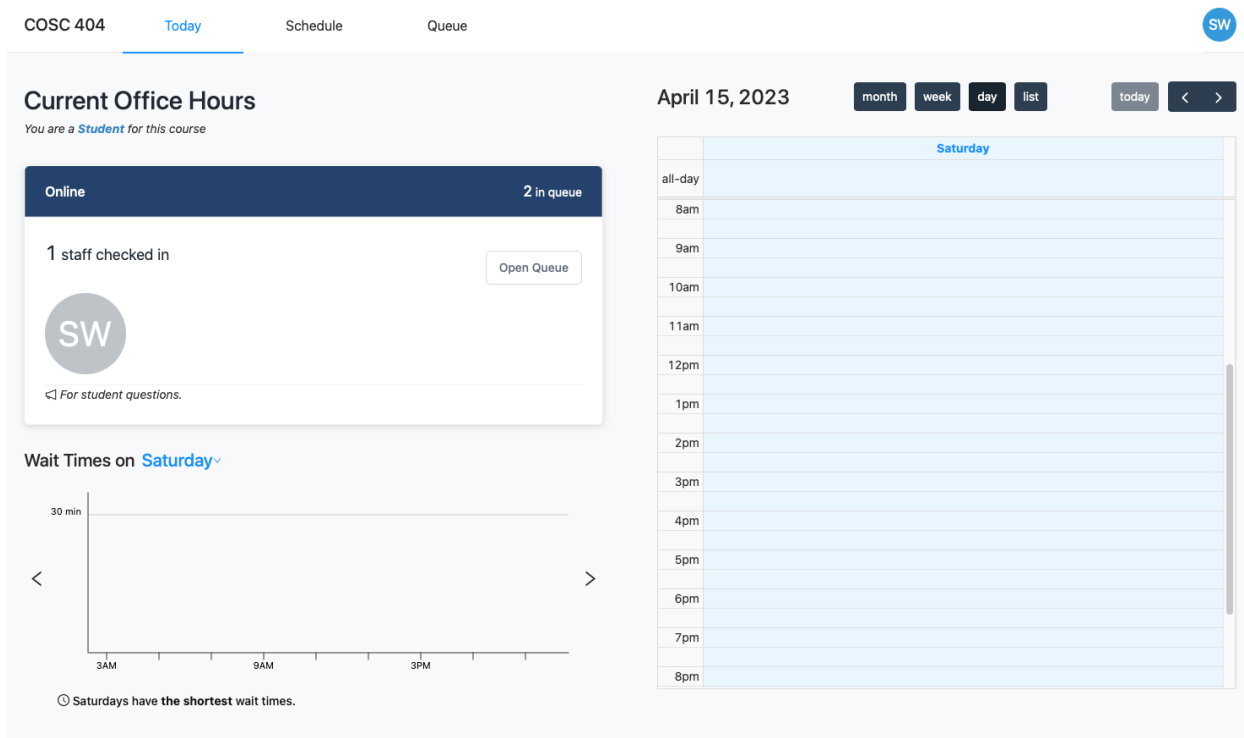


Figure 5. Student Queue View

Once a student opens a queue, they are directly sent to the queue page where the current line of questions is displayed, which is shown in Figure 6. All staff members and their statuses are shown. Each checked in staff member is either Available or Helping a student.

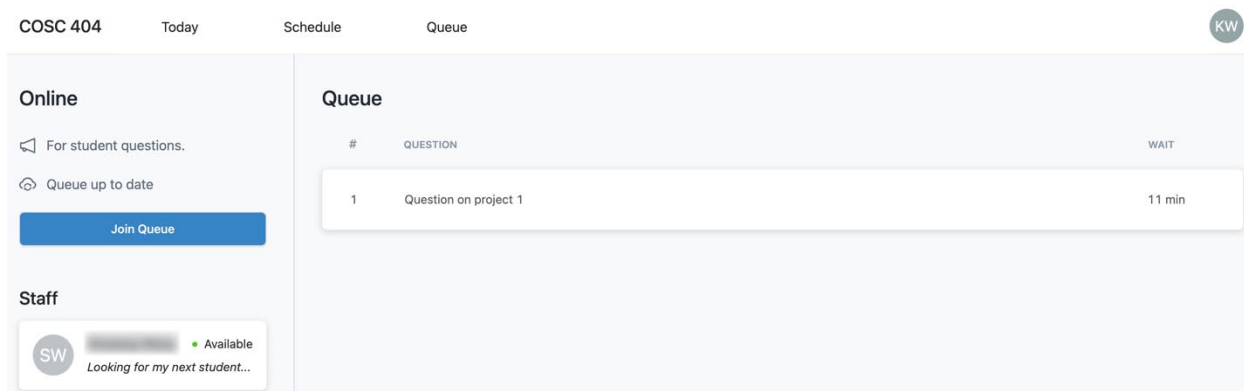


Figure 6: Student Queue

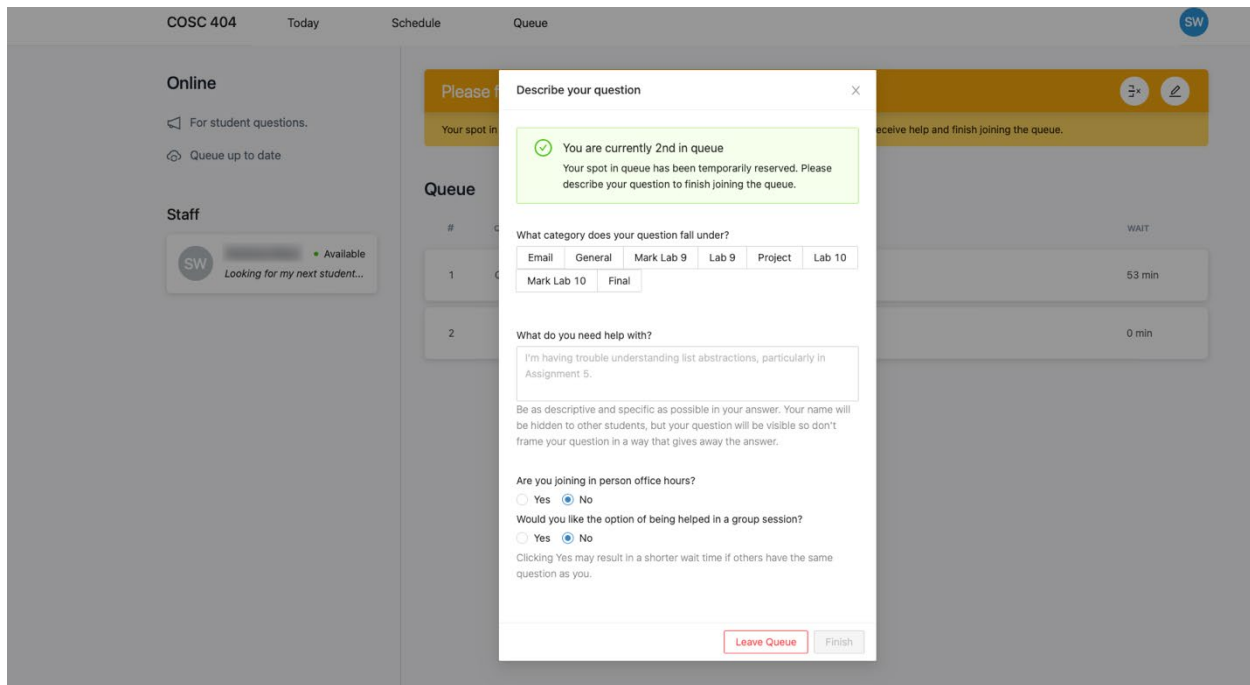


Figure 7. Student Creating Question

After clicking "Join Queue" in Figure 6, a prompt requesting question detail pops up as shown in Figure 7. Students must input text in *What do you need help with?* and choose the category of their question before clicking finish to submitting the question. The position of the student question is ranked by the time of creating the question draft, not the time of finishing drafting the question.

Figure 8 shows the student interface when their questions are in the queue. Their place in queue is displayed. Students have the options to update their questions and leave the queue at any time. They can observe the headers of other questions and each question's wait time, but they cannot see other student names or details.

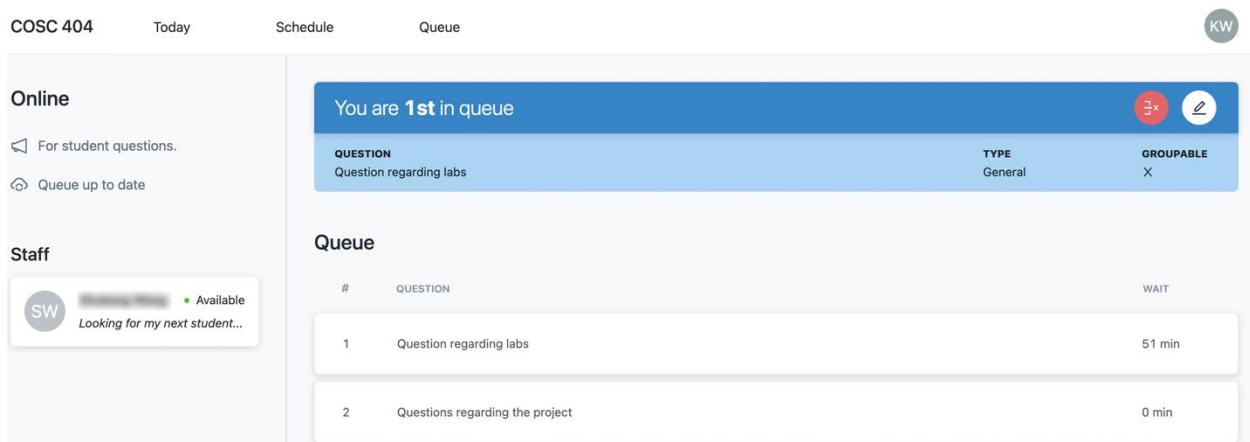


Figure 8: Student in Queue

Once their question is asked, a student waits in the queue until an instructor or TA comes to help them. Then the UI will display the change of status shown in Figure 9. Student Notified of Their Turn for Help The white button on the upper left corner of Figure 9 will lead the student to the Zoom meeting of the help session.

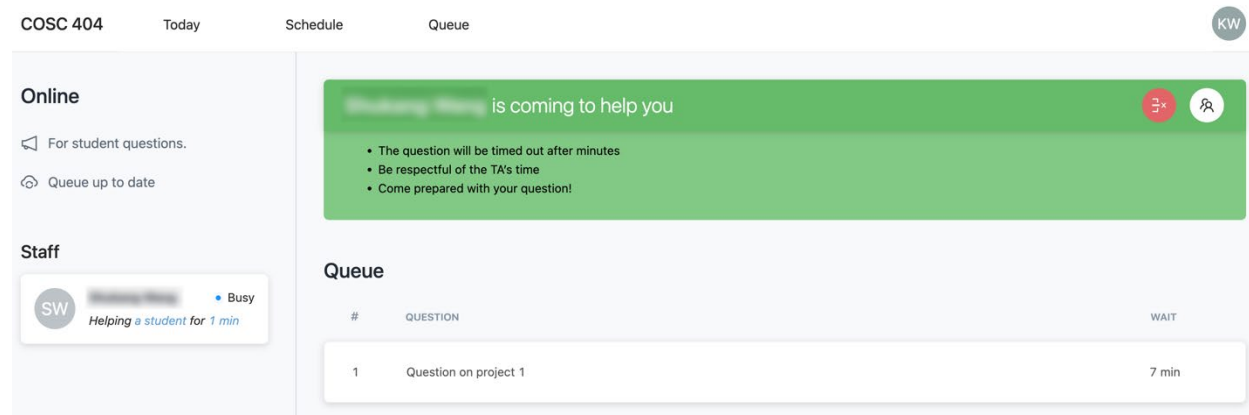


Figure 9. Student Notified of Their Turn for Help

When the interaction is concluded, either the student clicks leave queue or Instructor/TA closes the question. The student interface goes back to Figure 6.

### 3.3 Staff View

The staff homepage always displays active queues. Figure 10 shows the home page for a staff user. The interface shown is that of a professor staff, which is similar as a TA user, except for the welcome message, extra Admin Panel, and Insights page.

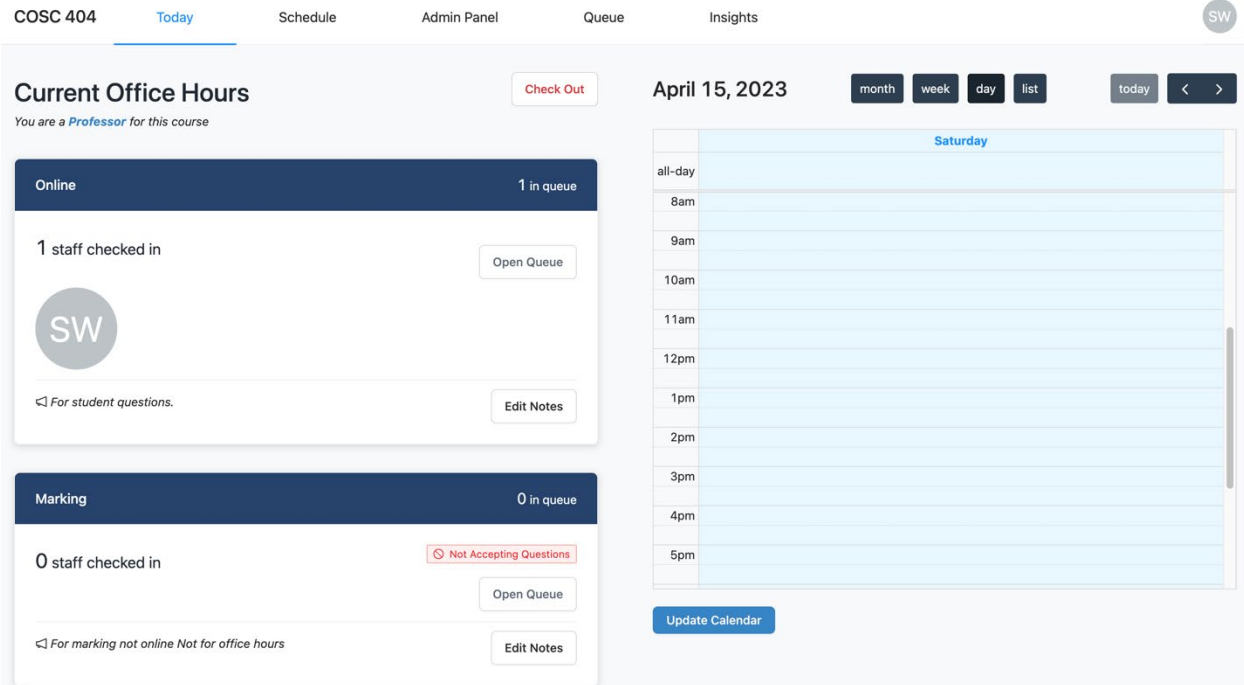


Figure 10. Staff Homepage

Figure 11 shows the queue UI when the user checks in. When the staff user is checked in, students can proceed to post questions, which can be seen in the middle section. Question details and options with the questions are shown by clicking on individual questions.

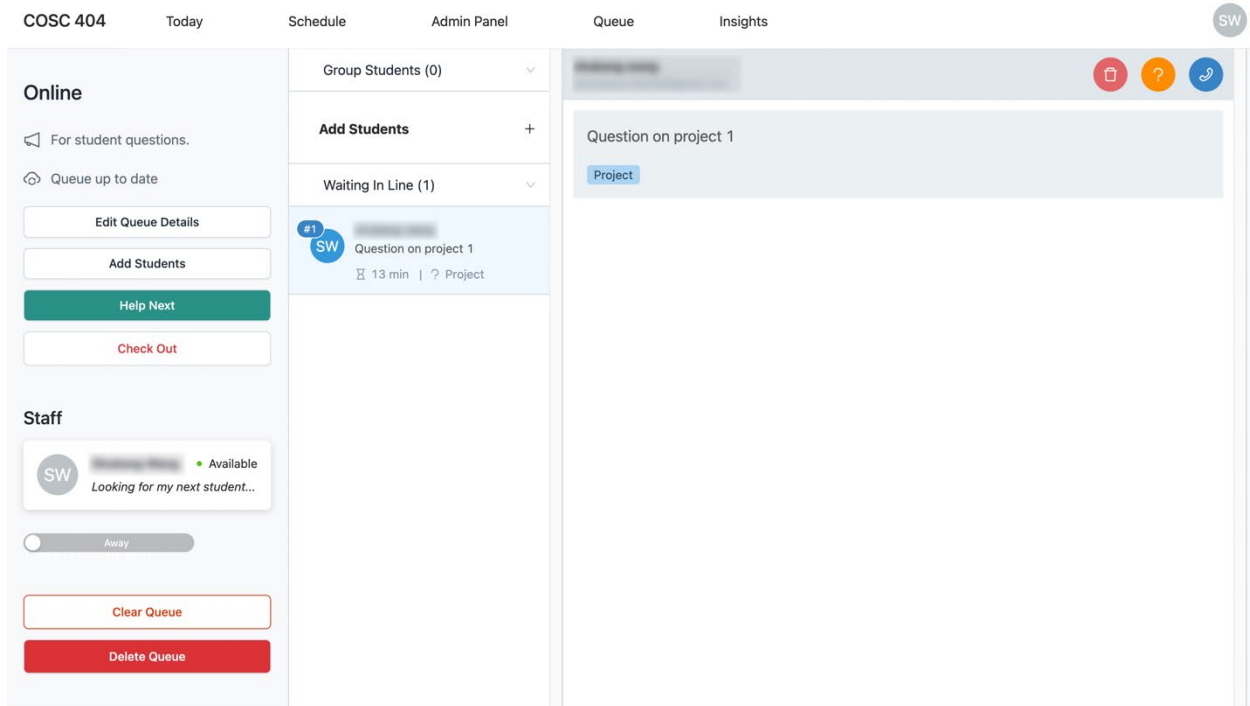


Figure 11. Staff Queue Idle

Note that if a staff user is not checked in, the queue defaults to not accepting questions and the staff cannot add students or help the next student. There can also be multiple staff members in one queue at any time helping different students.

Once a staff user clicks on the upper right button to initiate help, the interface changes to Figure 12. Here, a new section emerges in the middle that displays the student being helped. The staff now has the option to requeue the question, delete the question, or end the question using the upper right checkmark button. Each of these actions will redirect the interface to Figure 11.

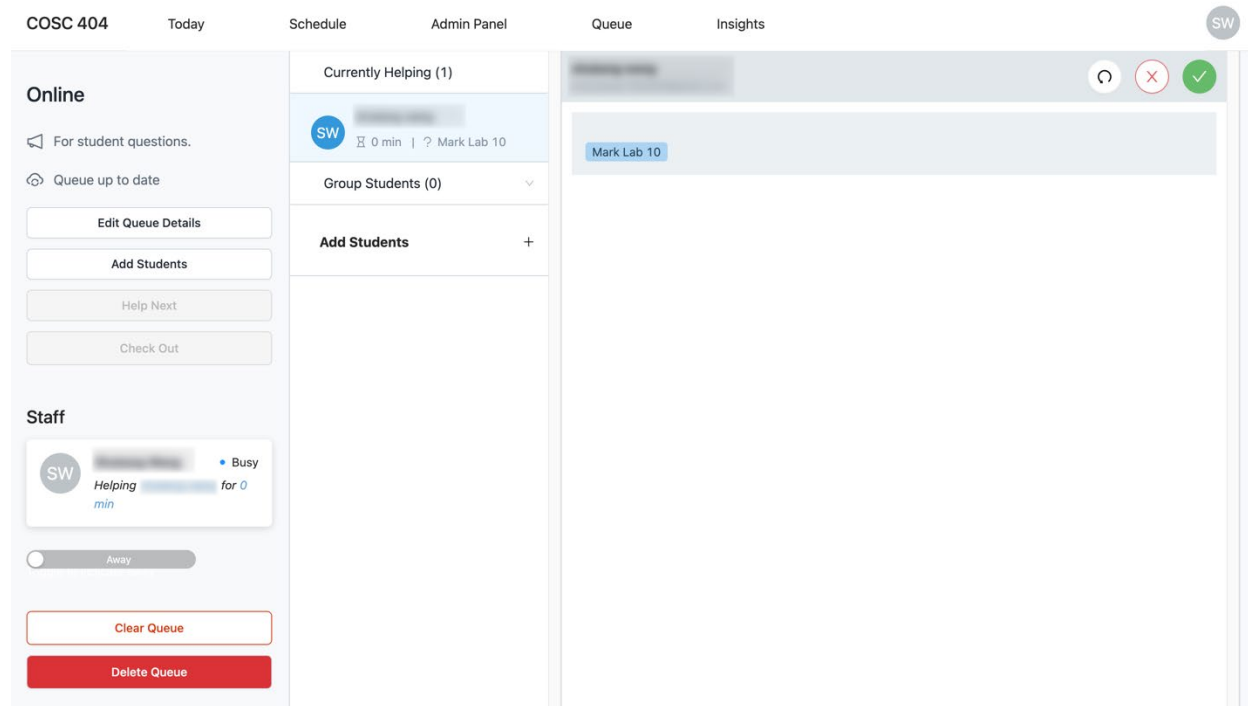


Figure 12. Staff Queue Helping

Staff can also edit the queue details in the Edit Queue details pop up as shown in Figure 13. The configurable areas are queue notes, status of the queue (accepting question or not), question types students can choose from, and Zoom link for the help sessions.



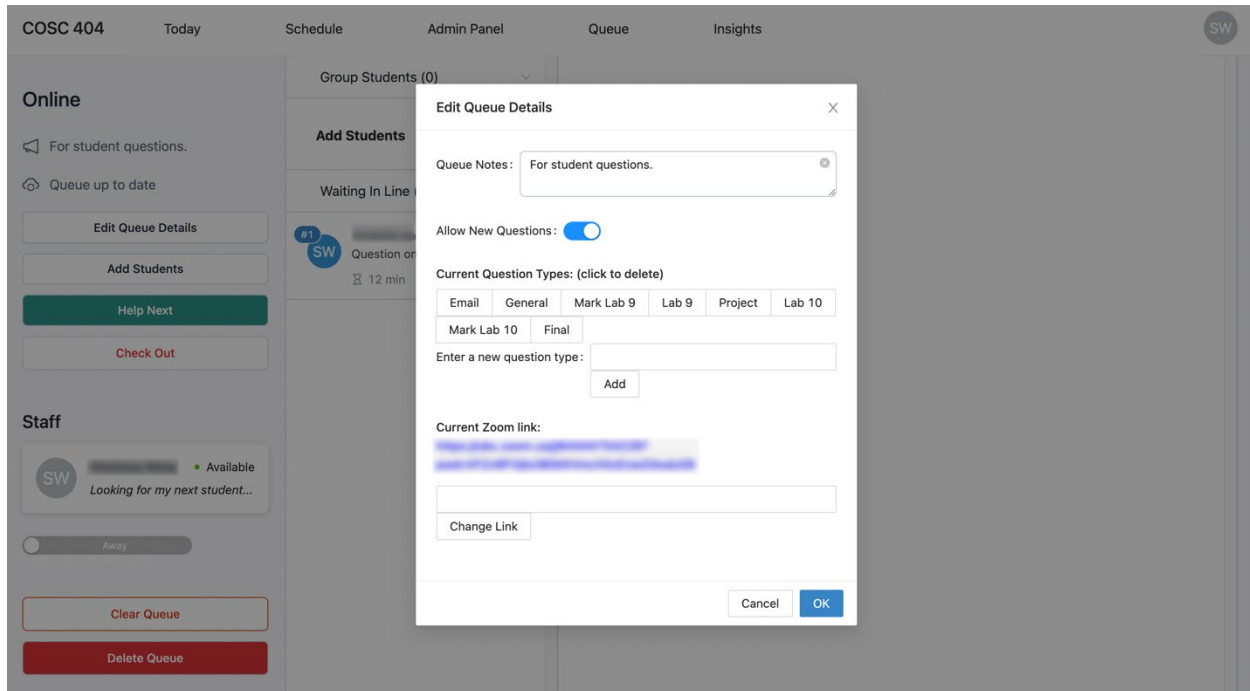


Figure 13. Staff Edit Queue

A staff can also manually add students to queue in the Add Students pop up in Figure 14. Here, a staff can add a student by searching for their name.

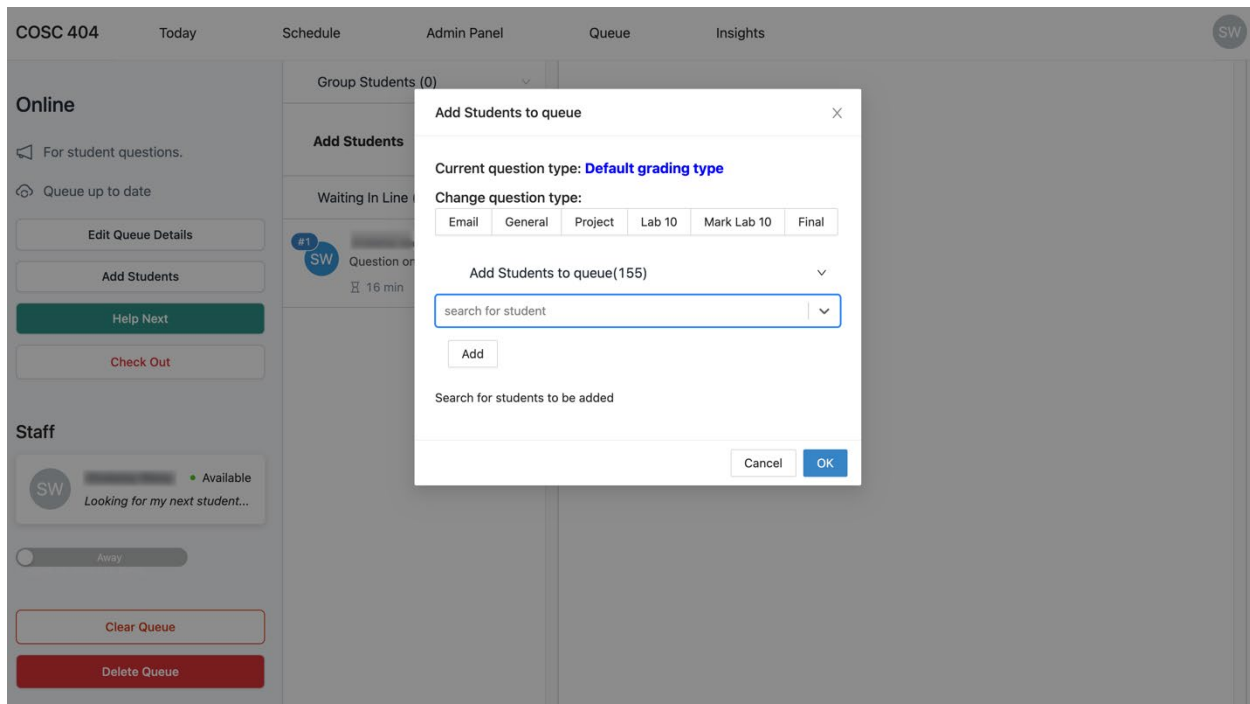


Figure 14. Staff Add Students

Outside of the main queue feature, professors have the Insights page and all features in Admin Panel page.

The Insights page (Figure 15) is readily available to professors, and it summarizes important data about questions. These data provide quick summaries of help session efficacy.

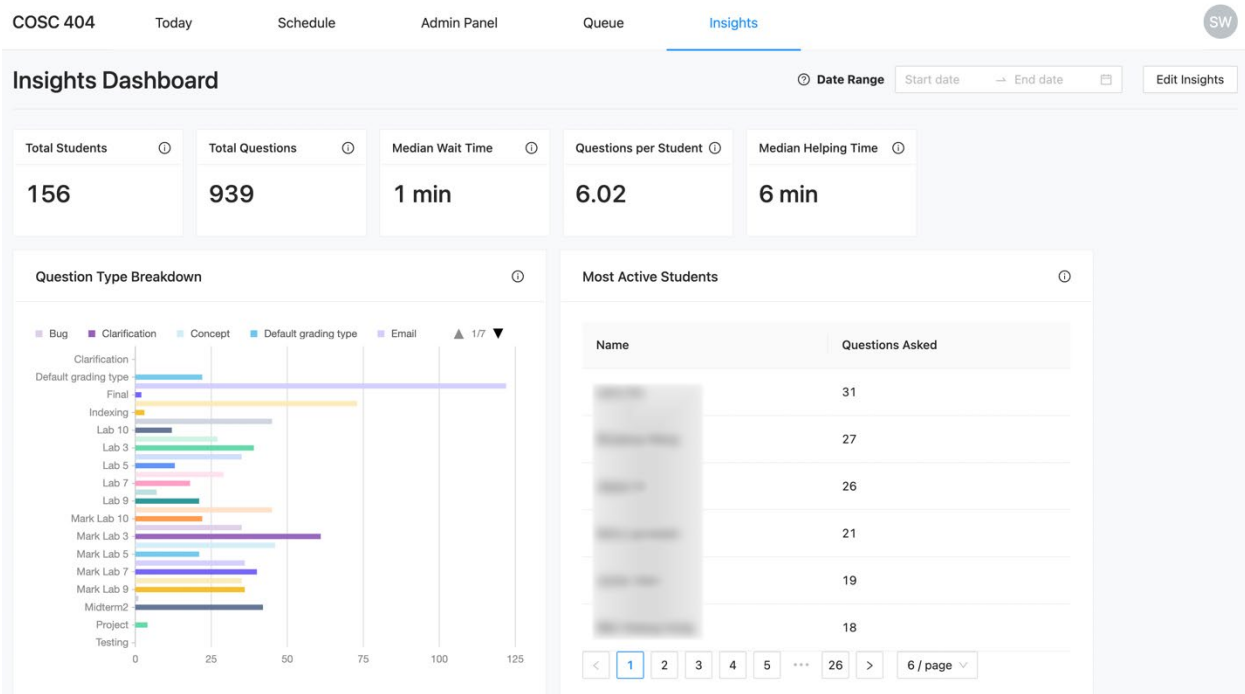


Figure 15. Professor Insights page

### 3.4 Data Collection and Analysis

HelpMe records many data points, which includes question length, wait time, TA online period, question text, question types, asker and helper info, and location of interaction. Some of the data are summarized by the Insights page, but it can also be downloaded through Export questions section of the Admin Panel in Figure 16. A staff user can only do this action.

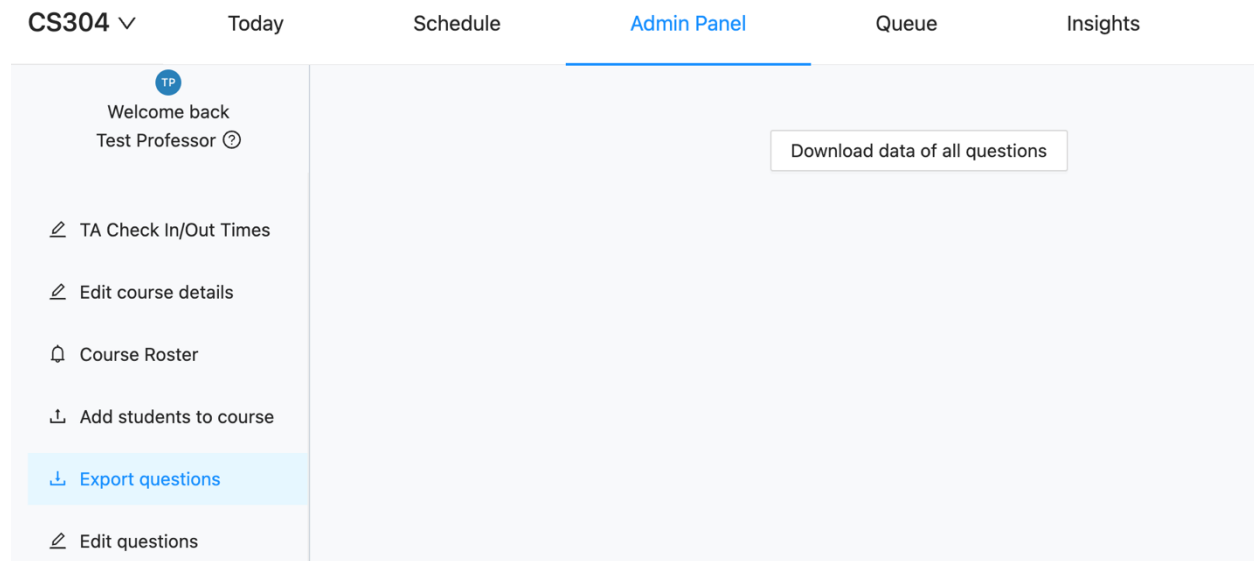


Figure 16. Export Questions

The downloaded file is a comma separated file, and an example of the file is in Figure 17.

id	Asked	text	questionType	createdAt	helpedAt	closedAt	status	location	askerName	helperName
21	1	For grading	Lab 1	2023-01-12	2023-01-12T21:54:55.957Z	2023-01-12T22:05:17.779Z	Resolved	null		
20	1	Docker setup issue	Lab 1	2023-01-12	null	null	Confirmed	null		
22	1	For grading	Lab 1	2023-01-12	2023-01-12T22:08:57.342Z	2023-01-12T22:16:00.905Z	Resolved	null		
37	1	mark lab 1	Mark Lab 1	2023-01-16	2023-01-16T22:11:38.107Z	2023-01-16T22:16:02.427Z	Resolved	null		

Figure 17. Downloaded Question Data

### 3.5 Other HelpMe System Features

HelpMe has a complete registration/login system, professor course management features, and multicourse support. These components are not discussed in this thesis.

## 4. Methodology

This research uses both survey and quantitative data.

The primary quantitative data is from the HelpMe system, which provided instructor-student interactions. More specifically, this research used the wait time and help time of questions, types of questions, time at which questions were asked, location of questions, and user information in the questions from HelpMe. The second set of quantitative data came from the midterm exam scores of consenting participants.

The HelpMe system was utilized in the COSC 404 class. Before the class started, the class was informed of the research study being conducted and provided a consent form to agree for their data to be used in the study. The instructors and TAs were trained on how to use the HelpMe system. Students were instructed that all in-person and virtual office hour sessions would be organized using the HelpMe system. Students who did not register themselves in the queue were manually added by the instructor and TAs. The HelpMe system was collecting help session interactions throughout the course until the end of the semester.

The process of collecting email interactions was done manually through the HelpMe system by the instructor. Whenever he responded to a student email regarding the course, he would check into the course queue on HelpMe, manually add the student question to the queue with the question type as "email". He closed the question on HelpMe after responding to the email. As a result, the final analysis contained basic records of email interactions between students and the instructor. While this process occurred outside of allocated help session time and required more effort from the instructor, we were able to obtain extra useful information.

The calculation of the overall help session utilization rate was done through calculation of time stamps on each question. First the length of each question was calculated through subtracting the question start time from the question closing time. Then the length of each question from HelpMe was added together to become the total time in help sessions. The rate of utilization throughout the semester = total time spent on question/total allocated help session time.

A survey was provided to the students in the last two weeks of class regarding their opinions on the HelpMe system and assignment incentivization. The survey data was used to answer questions such as current student opinions towards office hours and the efficacy of HelpMe as a new tool. We received 51 responses in total for a 47% response rate.

Interviews with the instructor of COSC 404 and teaching assistants were conducted to find out more about staff satisfaction with the system and to discover areas of improvements in the system.

## **5. Results and Analysis**

This section analyzes the data and presents results to the research questions. The data analysis was performed using Excel from the collected HelpMe question data, survey data, and student grades.

### **5.1 Student Behavior Regarding Help Sessions**

**RQ1: What challenges are present in office hours at UBC and what type of questions are being asked?**

Table 4 shows how students preferred to ask questions outside of the class before they used HelpMe. Only 24% of respondents preferred asking questions through office hours while the rest liked other channels such as email and after class. These data showed that help sessions had not been the favourite methods to seek help.

Through the HelpMe system, we also measured the percentage of students in class who asked general questions, the ratio of general questions compared with assignment related questions, percentage of students who went to office hours, the percentage of office hour time spent on helping students, the wait time of questions, and the email questions asked. In the result, we observed several important metrics. The first one was that students went to help sessions mostly for grade related and specific questions (lab questions and midterm questions) instead of general questions regarding slides and other aspects. The amount of grade related questions was almost 10 times that of general questions. We also observe through Table 1 that 93% of students had attended

help sessions for marking or labs at least once while only 29% of students had ever asked general questions.

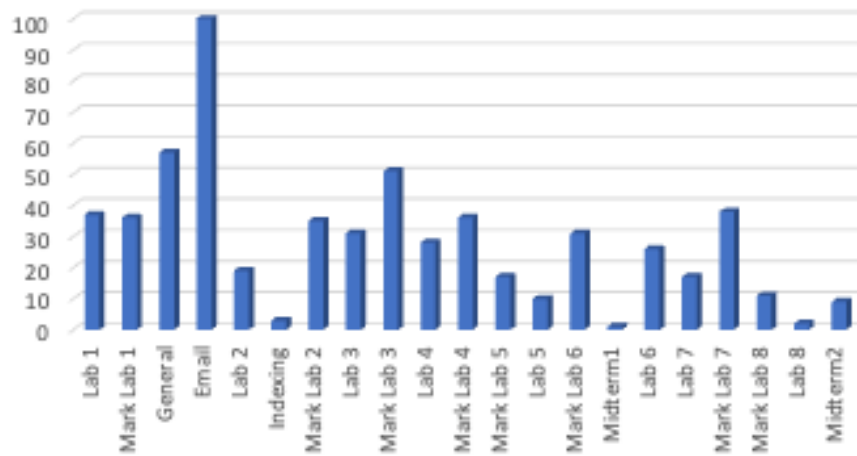


Figure 18. Question Types Distribution

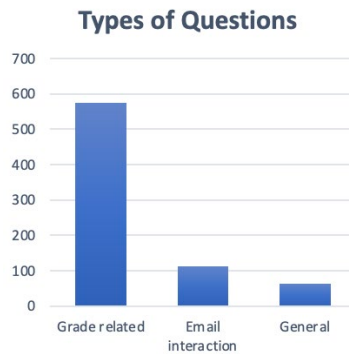


Figure 19. Types of Questions

	Count	Percent of students in class
General questions	31	29%
Assignment related	99	93%
Email	51	48%

Table 1. Question Distribution

About 51.4 out of the 124 hours of allocated help session time (41.5%) are used in questions. If we discount the lab marking interaction questions where students only tried to mark their labs, about 35.7 out of the 124 hours (28.9%) are used in actual questions. The actual time used through questions might be much lower overall if the class did not have an incentive for marking labs early, as students are less likely to ask questions regarding assignments without the bonus of completing labs correctly. On the other hand, the allocated help session time is 124 hours for the 62 teaching days of COSC 404, but the actual time is higher as all three staffs of this class would join the Monday help session if there were many students in line. As seen in Figure 20, there were many days (all Mondays when the highest bonus is given) where the rate of utilization exceeds 100%,

meaning that the total help time is over 2 hours. This suggests that there were more than 124 hours of help sessions time, which further lowers the actual utilization percentage.

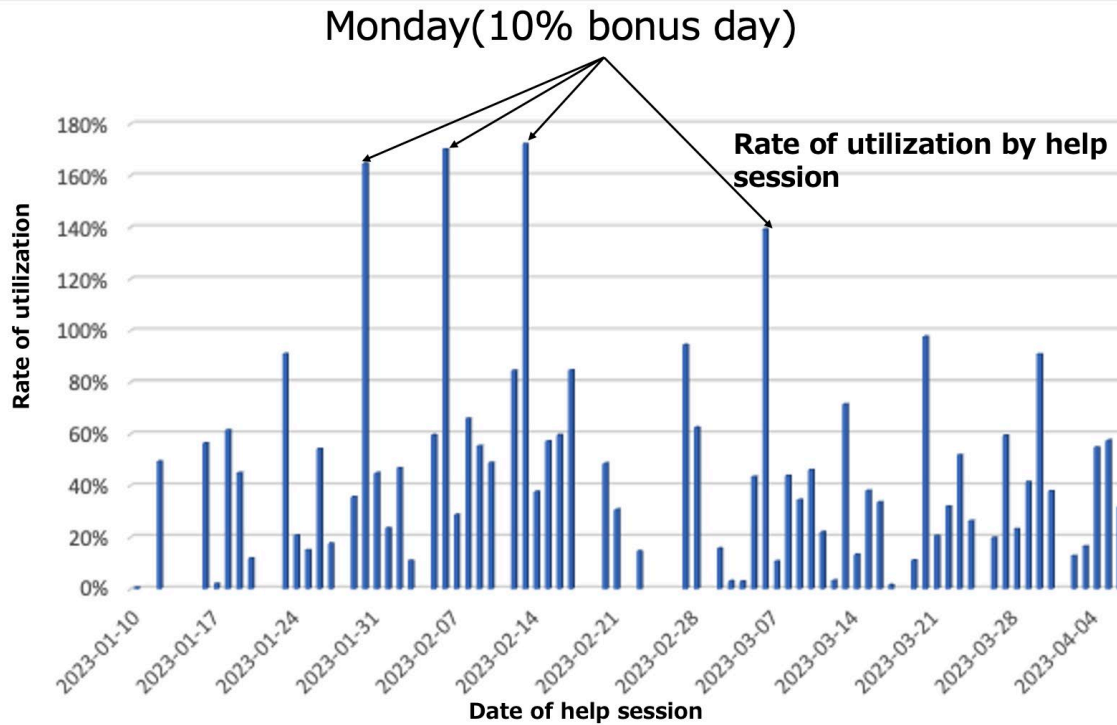


Figure 20. Utilization Rate by Day

Figure 20 also shows that utilization was very low on days when there are no bonus marks, and the uneven distribution of office hour attendance raises concerns on the future of help sessions.

Consistent with previous research, we found that office hours face challenges such as underutilization. We also found that students are much more willing to ask questions that are directly related to grade improvements.

## 5.2 HelpMe System Effect on Student Satisfaction

### RQ2: Does the HelpMe system increase student satisfaction and have a positive effect on office hours?

We asked students about the satisfaction of their experience with the HelpMe system and whether they thought that HelpMe was an improvement to office hours in other courses. Table 2 showed that students indicated HelpMe was a great tool that they would want to continue to use. They agreed that HelpMe improves visibility of status and makes office hours better and efficient.

Question	Score
The HelpMe system provided more visibility on my wait and service times for office hours.	4.44
The HelpMe system improved office hours compared to other courses.	4.26
The HelpMe system helped make office hours more efficient.	4.23

Students scores on a scale of 1-5: 1= strong disagree, 2=disagree, 3=neutral, 4=agree, 5=strong agree.

Table 2. HelpMe System Satisfaction

As expected, many comments in the survey also point out that the system is extremely helpful especially in the aspect of high visibility. For example, one student commented that “I enjoyed knowing where I was in line and being able to see the statistics for average wait times.”

An unexpected area of improvement through HelpMe was highlighted in another comment that claimed the system makes help sessions fair. Finding out the next student to be helped can be monitored through a physical line in front of an office, however, it might not be as easy in meeting software like Zoom. HelpMe did away with this problem.

There were also useful negative feedbacks, which mostly bring up a confusing integration between HelpMe’s queue and the actual place of help (Zoom). Many students felt lost in the beginning with the separate HelpMe and Zoom office hour combination. However, this issue that had been fixed in the upcoming version does not discount the overall helpfulness of the system. Overall, HelpMe increases student satisfaction in help sessions and is a tool that students would like to benefit from. This has confirmed previous research on help session utilization in office hours.

### 5.3 Assignment Incentivization and Student Performance

#### RQ3: Does a grade incentive in completing assignments early and attending office hours help CS students in learning?

From the data on HelpMe, we were able to obtain the number of times a student comes to mark their labs early (checked marks). This statistic for each student was compared to their test scores. However, there was not a significant correlation between number of labs marked early and test scores. Figure displays the number of times a student checks homework early compared with midterm exam averages. The lower average for students with less checked marks could be attributed to original ability level of the student, as more capable and motivated students with higher test scores are also more likely to complete assignments early and correctly.

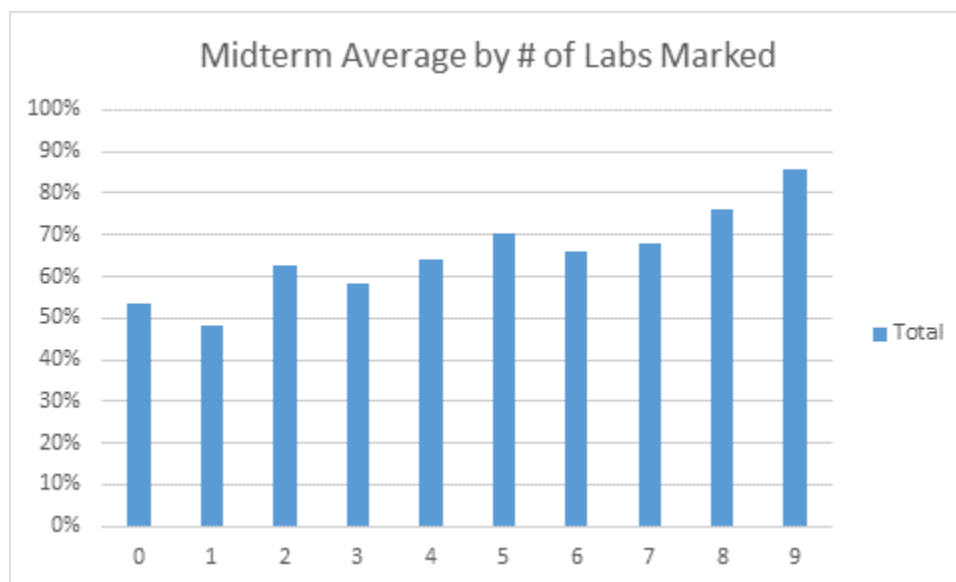


Figure 21. Midterm Average vs # of Checked Labs

Despite not observing significant correlation between test scores and the number of checked labs, there were other benefits from assignment incentivization overlooked by the comparison in Figure.

Students reported that they were motivated to finish assignments earlier. Table 3 containing student answers to certain survey questions shows that students are motivated to complete assignments earlier and attend help sessions more frequently. Completing assignments early likely also contributed to attending help sessions more frequently. Such behavior helps significantly with learning, as students have more time for assignments and to ask for help in help sessions instead of putting off assignments to the last minute.

Question	Score
Receiving bonus marks for early assignment completion motivated me to finish assignments earlier.	4.78
I attended office hours more frequently due to the bonus marks.	4.43

Students scores on a scale of 1-5: 1= strong disagree, 2=disagree, 3=neutral, 4=agree, 5=strong agree.

Table 3. Student Report on Assignment Incentivization

Overall, assignment incentivization achieved the goal of motivating students, thus making it a useful tool that enhanced learning.

## 5.4 Help Session Interactions and Student Performance

### RQ4: Does interaction with staff correlate to student performance?

Figure 21 and Figure 22 show that office hours visits (help session interactions) were not strongly correlated with exam performance. There was a slight correlation between exam average and number of office hour visits. However, this small trend might be due to the attitude of a student; if a student cared about the class enough to show up to help sessions, then they would do better on tests as they probably also cared more about test preparation and assignments in class. The better performance on the test thus might not be a result from being helped in help sessions.

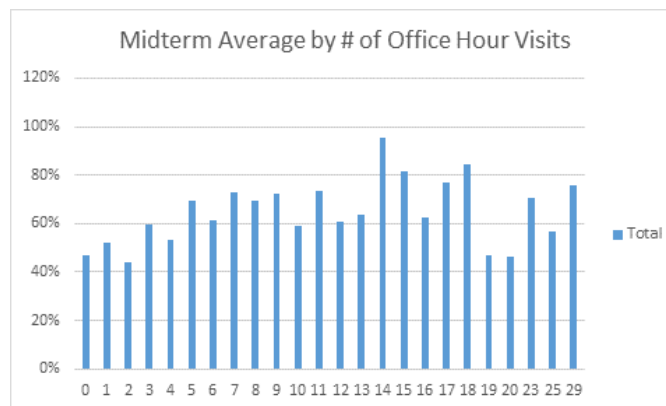


Figure 21. Midterm Average vs # of Office Hours Visits



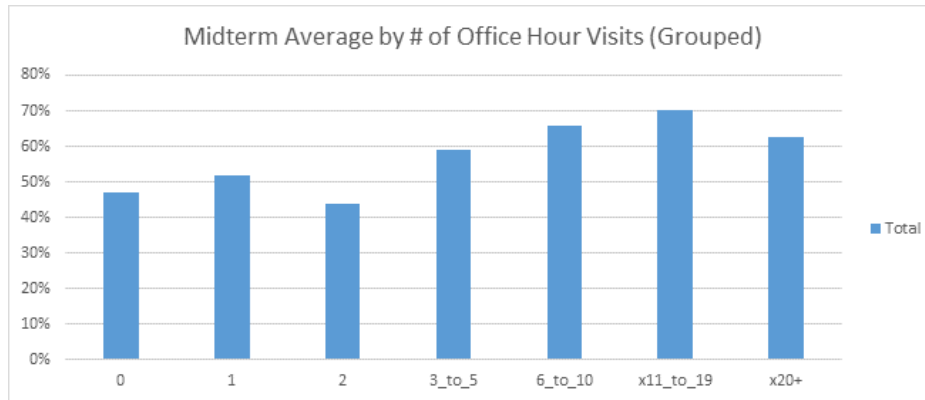


Figure 22. Midterm Average vs # of Office Hour Visits Grouped

Overall, the number of help session interactions were not shown to be a great indicator of student test performance.

## 5.5 Changing Student Behavior

**RQ5: If the HelpMe system and assignment incentives improve student satisfaction and performance, do they change student behavior in seeking out of class help?**

Table 4 shows that student attitudes changed with the introduction of HelpMe; while only 24% originally preferred office hours, 63% would prefer virtual office hours with the HelpMe system, a huge change in attitude towards synchronous office hours.

	From previous courses	After using HelpMe
Office hours	24%	10%
Email	42%	16%
Did not seek help	22%	10%
After class	12%	0%
Virtual Office Hours (with HelpMe)	N/A	63%

Table 4. Preferred Help Seeking channel: Before and After

## 5.6 Instructor and Teaching Assistant Satisfaction with HelpMe

**RQ6: Is the HelpMe system a helpful tool for instructors and teaching assistants?**

In the interview with instructors/TAs of the class, the most helpful aspect of HelpMe is the office hour management; it helps in finding the next student in line. The instructor in COSC 404 implements a hybrid office hour for both students online and in person, which creates a problem of tracking status of the separate queues and notifying students on the two queues of the actual status. HelpMe effectively resolves this problem. The professor also cited the importance of data collection through HelpMe.

The instructor and TAs also claimed that the system was easy to learn as a focused system despite some small features that can be better streamlined. One of the TAs also mentioned it was very helpful for him to see a description of student questions on the queue system, which enabled him

to prepare for answering the questions. He also observed that students were more organized and prepared when they showed up for the questions.

The instructor also offered some recommendations for the HelpMe system, which are to develop a better UI, improve mobile access (should be very common), and add onsite data analysis that is easily accessible by Instructors.

## **5.7 Results Discussion**

Regarding the hypothesis that an office hour queue can improve help session experience for both students and staff, we found positive feedbacks. Students almost unanimously agree that HelpMe improves help sessions, and almost half of the students even go as far as to switching their preferred method to help sessions with the aid of HelpMe. Many extra comments on help sessions and HelpMe system such as “the office hour using this HelpMe system really organizes things, this is honestly great” and “Liked the structure, continue using!” show genuine likeness of the system from students. Furthermore, it was shown that HelpMe can be a great asset for the instructor and TAs, who can use the tool in many ways to manage help sessions better. It also offered quantitative data for questions in the class, which is a great source conveniently given to instructors.

There are limitations to the first conclusion. The positive feedbacks could be influenced by other factors of COSC 404, as students enjoy a flexible help session schedule where all staff members are available to help when there is an influx of students. While this drives down the wait and increase student satisfaction, it is not a benefit created by HelpMe. It would be useful to conduct research on the tool through comparisons of different classes with different approaches to implement help sessions. Furthermore, COSC 404’s classroom was used by another course immediately after ending, thus blocking out much of the chance to interact after class. This might have driven more traffic to the HelpMe system. Overall, more research should be conducted on HelpMe’s effects.

Regarding the other part of the hypothesis on assignment incentivization, there was a lack of correlation between attending help sessions and student test performance or correlation between assignment incentivization and student test performance. This result was not surprising, as test performance and student learning should be hinged upon the class content. While help sessions can help, most of the learning comes down to student abilities and motivation. It is worth exploring more on whether tools for help sessions and assignment incentivization influence students’ experience in general during their college experience.

In the meantime, student behavior in class changed for the better as they completed assignments earlier and attended office hours more frequently, boosting the overall learning for the whole class. We can still say that assignment incentivization is beneficial for learning.

In the end, COSC 404 is an upper-level class with students who likely have a better grasp or more ready to take on new knowledge in the field. It might not be the best representation of the computer science field.

## 6. Conclusions

Through the initial analysis of the data, we first conclude that HelpMe, as a queue system with added features, effectively increases student and faculty satisfaction in help sessions. The response to the system even showed a transformation in student attitude towards help sessions. This effect of implementing queue systems in help sessions can be more significant than previous research has suggested.

In the meantime, we found that incentivizing students to complete assignments early and correctly with bonus marks is a very useful technique to encourage interactions and enhance learning. Combined, these two aspects can potentially bring huge change in help seeking outside of classroom, motivating students to perform better and providing more essential interactions between different people in a university.

On an ending note, the instructor also offered an interesting perspective on office hours and TA mentor sessions, claiming that Help Sessions are designed for short questions and answers, as the limited time in Help Sessions do not scale to have long tutor sessions for students. He also mentioned that Help Sessions inherently assume that many students do not attend. Such a vision of office hours differs from many of the early educators in higher education who believe that office hours are a channel of human connection rather than just Q&A sessions. Computer Science is a relatively new field with different dynamics, which leaves the bigger open question of what Help Sessions are supposed to accomplish and thus also how can HelpMe and other technologies evolve to help with that vision.

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