The Efficacy of Online Office Hours: An Experience Report

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Abstract

To facilitate assisting students while online during the COVID 19 pandemic, we transitioned to online office hours. These were managed by an automated queue which kept track of who was waiting in office hours, and for how long. We combined data about office hour usage with students' project commit and grade history. These data afforded us a unique look at the efficacy of office hours that the usual, casual drop-in style office hours, did not allow. Amongst other findings, we saw that while individual office hours visits did increase student grades, more visits during the term was negatively correlated with the final project outcome.

CCS Concepts: • **Social and professional topics → Computing education**.

Keywords: computer science education, online office hours

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1 Introduction

Office hours afford students the opportunity to discuss course work and concepts with instructors and teaching assistants (TAs). Prior to the COVID-19 pandemic, our TA, project help office hours were generally held in person, in a casual drop-in style. The pandemic forced us to move office hours online; students signed up for an online queue and when it was their turn we met with them over Zoom. Our queue system kept track of who was waiting in office hours, and for how long.[1]

Projects were graded every time a student committed their code (whether they requested a grade or not), and because they committed somewhat frequently so they could share their changes with their partners, we were able to combine student grade data with the office hours queue logs to provide us a unique look at the impact office hours usage had on the project outcome.

With these additional data we sought initial insight into how students leverage office hours and opportunistically examine a range of questions from the January–April 2021:

1. When did students make use of office hours?
2. How did grades change before and after office hours?
3. Were longer visits more helpful than shorter ones?
4. Did longer periods of independent work positively influence grades?

We begin by setting out the context for this work (Section 2) and examine how students use office hours (Section 3). Related work is described in Section 4, followed by implications and threats (Section 5).

2 Context

We teach a 3rd year software engineering course with 17 TAs and over 250 students per semester at a large, research-intensive university in North America. In addition to other course work, students work in pairs to complete a project

[1] In accordance with Article 2.5 of TCPS2 [6], the Canadian policy framework governing research ethics, these data were collected for QA/QI activities.

worth 40% of their grade; both teammates share a common project repository. The project is split into four deliverables with deadlines throughout the term. Their project is automatically graded against a comprehensive unit test suite [1] every time they commit their work, but they only see the grade if they explicitly request it. The average grade for the project was 85.1%, and median grade was 94.7%. In our analysis we cluster students by their project grade's place around the median; while this resulted in unequally-sized groups, the groups matched those we were interested in gaining greater insight into:

- Students at 100%: n=16
- Students above the median but below 100%: n=110
- Students below the median but above 50%: n=122
- Students with a grade below 50%: n=14

Students receive TA support through an online forum (Piazza) and by visiting office hours. There were typically 18 hours of office hour sessions provided each week during the development period of each deliverable. We then added at least 24 additional hours in the final days leading up to a deliverable deadline. All office hours were held over Zoom. Students had to sign up for office hours on a web queue where they entered their question or area they needed help with, TAs then helped each student with a single issue before moving to the next student. The queue system tracked their project team, wait time, and duration of time spent with a TA working on their problem. The queue was a self-hosted web app. Students could add or remove themselves from the queue whenever office hours were in session.

3 Observations

In this section we examine many aspects of how students accessed office hours and how their grades fluctuated throughout the course.

3.1 Students' Use of Office Hours

Each student attended office hours on average 5.29 times with a high standard deviation of 8.35. Some students went to office hours dozens of times throughout the term while 36% of students never attended. Office hours visits peak dramatically at each of the project deadlines, as shown in Figure 1, which shows the count of unique visitors over the term where the black vertical lines indicate deadlines.

We saw the increased demand push wait times up from a median of 42 minutes during the first deliverable's development period up to a median of 124 minutes during the final deliverable's. However, the total number of students accessing office hours each day only increased over time, suggesting that wait times did not deter students from obtaining help.

The time students spend with a TA until their question is answered varies from 1 minute up to 112 in our data set, with a mean of 19 minutes and median of 15. This mean varies little throughout the term. During the development periods of each of the project's deliverables, the mean time spent with a TA was 15 minutes for the first deliverable, and 18 minutes for the three remaining deliverables.

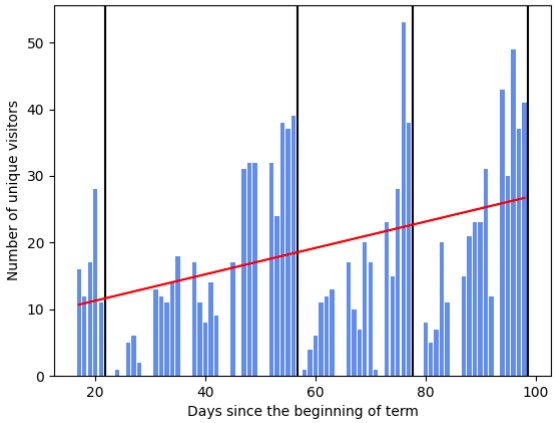

Figure 1. Unique students in office hours per day over the course of the term. Black vertical bars represent deadlines.

Not all students used office hours. Broken down by grade group, for those who did use office hours:

- Of students who obtained a perfect score of 100%, 61.5% visited office hours
- Of students who obtained above the median but below 100%, 39.3% visited office hours
- Of students who scored below the median but passed, 48.8% visited office hours
- Of students who failed (score below 50%), 63.6% visited office hours

3.2 Students' Project Commits

As every student commit was automatically graded, we were able to track student performance across the term. Individual students made, on average, 0.96 commits per day, or 83.42 commits over the semester. Some commits improved student grades, some decreased their grades, and some had no change (visible in Figure 2). While there are many valid reasons for making a commit that does not increase the total project score (e.g., refactoring), students generally visited office hours for help when they were stuck and wanted to make grade-improving changes to their solution. When we group commits by grade outcomes (perfect scorers, above median score, below median, and failing scorers), we see that each group followed a very similar pattern, with the slight exception of students with failing grade outcomes who showed a higher proportion of ineffective commits.

By comparing number of commits with final project grade (Figure 3) we can see that while not all projects with strong

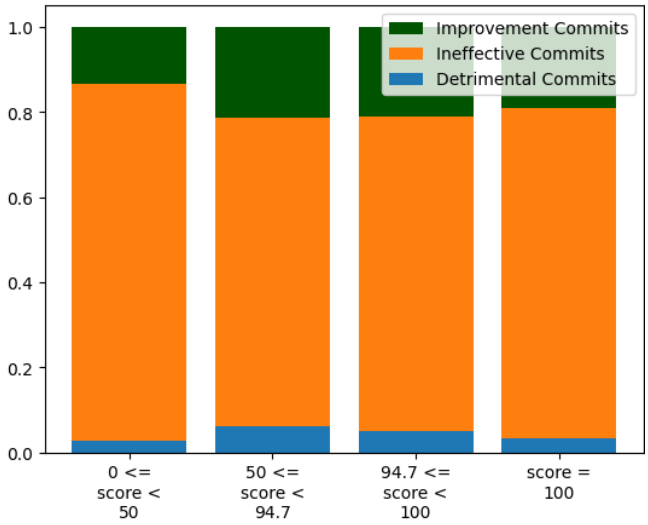

Figure 2. Proportions of improvement, ineffective, and detrimental commits across the entire semester, grouped by student project score outcome.

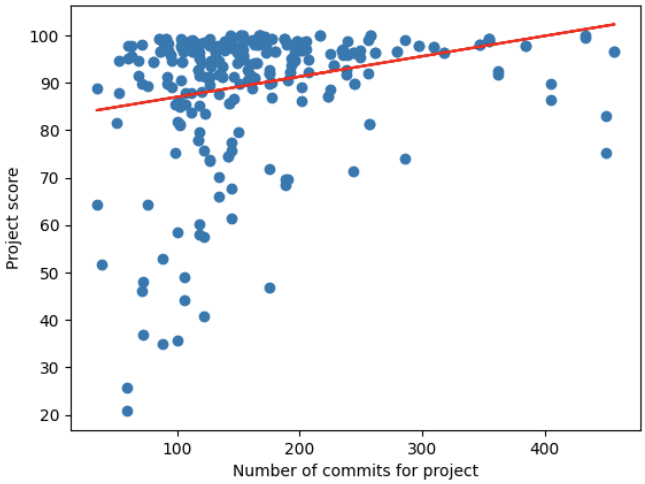

Figure 3. Total count of commits made to final project score.

final scores contained many commits, projects with many commits often achieved strong scores.

3.3 When Do Students Attend Office Hours?

We wished to assess the relationship of students' periods of active development (as measured by commits) to when they made use of office hours. Are periods of heavy activity sparked by a visit to office hours, or does the visit follow a period of stagnation? To collect this data, we plotted the number of commits created in one hour ranges within 24 hours of a visit to office hours. As seen in Figure 4, this plot shows a large spike in commit activity in the hours directly before *and* after a visit to office hours. The activity level drops to a low around 10 hours before or 15 hours after

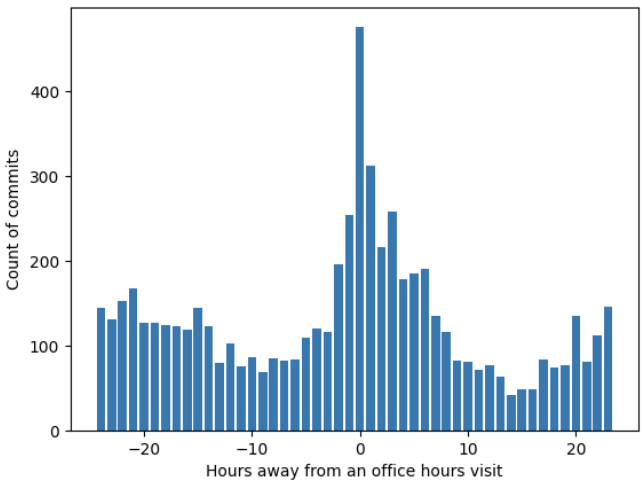

Figure 4. Count of commits created in one hour ranges before or after a student visit to office hours across the term.

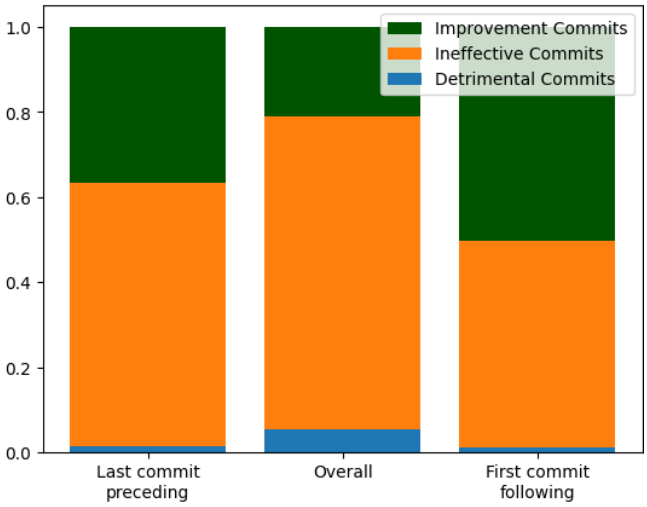

Figure 5. Proportions of improvement, ineffective, and detrimental commits, grouped by commits that immediately precede a visit to office hours, all commits in the term, and commits that immediately follow a visit to office hours.

office hours, and a small peak appears on either side around a day away. These results are similar regardless of project grade outcome.

These results suggest that visits to office hours and periods of active work on the project often coincide. We do not have data that can point to the explanation for *why* students coincided heavy activity and office hours visit, but we can conjecture that as office hours were provided frequently throughout the week, students who utilise office hours may choose to attend whenever they are actively working, since questions naturally arise during those times.

3.4 How Do Office Hours Influence Grades?

We wished to examine how effective commits were at affecting change to a student project surrounding a visit to office hours. This included examining the commits that may have motivated a visit to office hours, and the commits that followed office hours. We expected to see students entering office hours to be motivated by suffering a detrimental or an ineffective commit, and an improvement commit following office hours.

To assess the whole semester baseline, we determined the percent of commits where grades decreased, did not change, or increased. We then performed the same analysis on commits that immediately preceded a visit to office hours, as well as on commits that immediately followed a visit to office hours from the same project team. These results are shown in Figure 5.

We saw that overall, commits are most likely to have no effect on grades, but are more likely to increase than decrease grades. The pattern following office hours is the same, but there is a more pronounced difference between an increase in grades and a grade drop. Against expectations, this is also true for commits that immediately precede a visit to office hours. From this we can see that commits on either side of office hours were primarily ineffective, and that commits on either side of a visit to office hours were more likely to introduce positive change rather than negative change.

3.5 Are Long Visits Helpful?

As discussed in subsection 3.1, we observed that a single visit to office hours, while typically around 19 minutes in length, may extend upward of an hour long session with a TA. Do these longer sessions with a TA indicate that the student is getting a more helpful experience, or could they perhaps indicate that the TA is as stuck as the student, and unable to make progress?

In Figure 6 we plot the proportions of improvement, ineffective, and detrimental commits following a visit to office hours, grouped by the length of the time spent with the TA in the office hours visit. In a successive time range, we see an increase in detrimental commits, and a decrease in improvement commits, indicating that a increased proportion in improvement commits is not correlated with the length of an office hour visit.

3.6 Do Office Hours Gaps Influence Grades?

We wished to determine if the gaps between visits positively influenced grades. As educators we encourage students to do independent work before coming back to us for help; does following that advice lead to better grade outcomes?

To assess whether independent work duration influenced grades, we looked at how long students waited before returning to office hours, and the grade outcome segment into which they fit. We also looked at how many commits they had made, as a proxy for how much project work the team was doing in the independent work period.

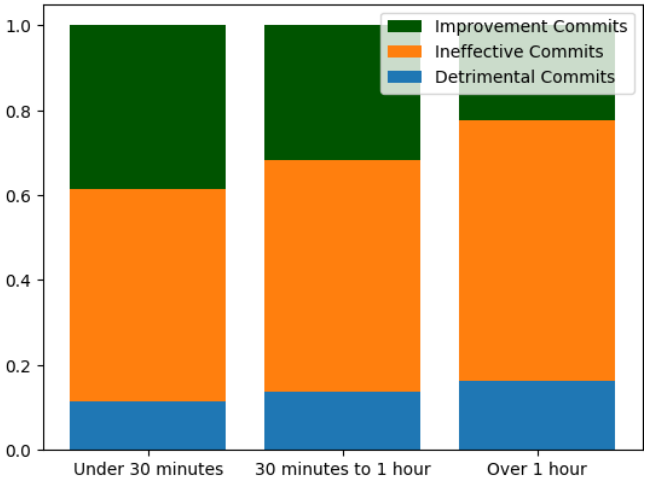

Figure 6. Proportions of improvement, ineffective, and detrimental commits following a visit to office hours, grouped by the length of time spent with the TA in the office hours visit.

- On average, students returned to office hours after 6.9 days, and after having created 3 new commits.
- Students at 100% waited 13.5 days and 3 commits on average before returning
- Students above the median but less than 100% waited 8.1 days and 4.24 commits on average before returning
- Students over 50% but below the median waited 6.41 days and 2.28 commits on average before returning
- Students with a grade below 50% waited 3.16 days and 0.49 commits on average before returning

This analysis suggests that students who use office hours and have a higher score outcome spend more time working independently before returning to get more assistance from a TA. Students who achieved a perfect score waited by far the longest, and made close to the average number of commits. Students who were failing waited very little time, and had done very little project work in the independent work period.

We also saw a negative correlation between grade and office hours usage. Figure 7 shows each student's count of office hours answers over the entire term to their final project grade. The red line indicates a gentle *negative* correlation with overall project score.

Together, these findings strengthen the support for educator intuition that students working independently before asking for help positively influences their grades, though more work is needed to determine the causal versus correlative relationship between grades and independent work.

4 Related Work

The published work on office hours in computer science education is sparse, perhaps because of challenges gathering

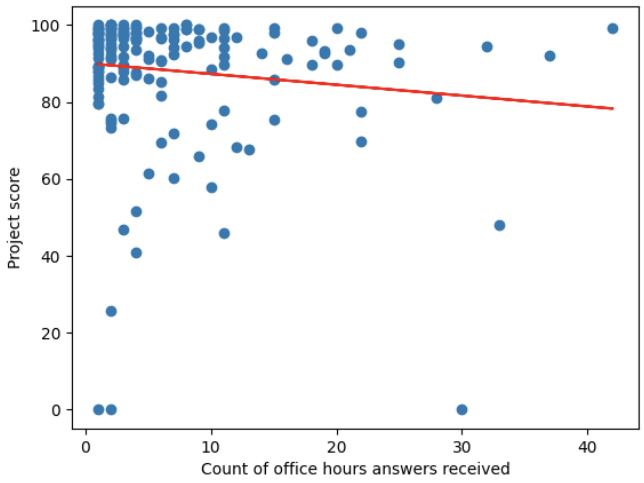

Figure 7. Count of office hours visits by project score.

data about in-person office hours, although Ren, Krishnamurthi, and Fisler have developed a lightweight mechanism for this purpose [8].

Over the past three years, Lin, Stephens-Martinez, and Railing have facilitated conference sessions for educators to share ideas for planning and evaluating office hours [e.g., 4].

Although far less common in the past, online office are not novel; Drexel created a tool for online office hours in 1998 [3]. Harvard introduced online office hours to their large, introductory CS50 course in 2007 [5]. They found that 55% of students attended online office hours while 62% of students attended in-person office hours and that wait times in the virtual setting were sometimes as long or longer than the in-person wait times. We did not keep track of wait times for in-person office hours, but anecdotally, wait times seemed longer when online, potentially because of the *one at a time* nature of help. In person, TAs could easily interleave help, whereas online, TA-time was much more dedicated.

The University of Illinois at Urbana-Champaign examined online office hour log files in conjunction with grades in a large sophomore computer science course [7]. They found that students who attended office hours had a significant grade increase on upcoming assignments but not on upcoming exams. They also found that the impact of an office hours visit on a student's grade decreased as the attendance time was closer to the assessment deadline. In our course, we saw that most students' first commit after visiting office hours either improves or does not affect their grade. We did not investigate exam grades in relation to office hours visits.

The University of Toronto implemented a swipe-card system that allowed them to track attendance at in-person office hours at a non-course-specific help centre [2]. They found mean and median service times similar to ours at roughly 15 and 11 minutes respectively, with mean and median wait times of roughly 34 and 29 minutes respectively. They also found similar variation in use of the help centre as we did; the number of visits per student ranged from zero to 71.

5 Discussion

Implications. While we were unsurprised to see that students seemed to be able to improve their project scores after visiting office hours, the negative correlation for students with many office hours visits is concerning. One possibility may be that these students would benefit from a modality *different* than office hours, such as a tutorial session or other more directed setting. While these students may be easy to identify at the end of a course, identifying which students could benefit from a different form of contact *a priori* would likely be challenging.

Threats to validity. There are several shortcomings of this initial study. Automatically assessed project grade is a simplistic proxy for student understanding. A qualitative understanding of student feedback about office hours may also offer additional insight into these visits from the student's perspective. The generalizability of these results beyond a large course setting is also unclear as smaller courses may be able to better tailor and structure office hours.

6 Summary

In this paper we have examined several questions regarding the experience of students making use of online office hours and its influence on grades, in our January-April 2021 semester.

We saw that students are more likely to experience a jump in grades after attending office hours, and we saw that students attend office hours during their heaviest periods of commit activity. We also, however, saw that independent work correlates with higher grades, with longer gaps between office hours visits aligning with better project grade outcomes, and conversely, more visits across the semester negatively correlating with final project grades.

A potential, conjectured takeaway for students might be that it is the quality of TA encounters, not the quantity that matters: Few TA encounters that are interspersed with independent work may positively influence their grade outcomes.

This work is preliminary, and does not offer hard conclusions about how students behave in office hours, or what benefits they derive – instead we seek to add this account of our experience as a basis for comparison against future work.

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