



Work in Progress: Mandatory Attendance in Office Hours to Improve Students' Learning Experience

Mr. S. Cyrus Rezvanifar, University of Akron

S. Cyrus Rezvanifar is a Ph.D. student in Biomedical Engineering at The University of Akron. He has also served as a research assistant in Cleveland Clinic Akron General since 2016, where he conducts research on biomechanics of human knee joint and patellar instability. In 2016, he received a doctoral teaching fellowship from the College of Engineering at The University of Akron. Through this teaching program, he has served as an instructor for several undergraduate-level courses, and he has conducted educational research on the effect of various learning techniques on improving students' self-efficacy and overall learning experience.

Dr. Rouzbeh Amini, University of Akron

Dr. Amini completed a Ph.D. in Biomedical Engineering at the University of Minnesota in the field of ocular biomechanics and biotransport in 2010. He then continued his research work on the mechanics of soft tissue as a postdoctoral trainee at the University of Pittsburgh's Department of Bioengineering, where he held the Ruth L. Kirschstein National Research Service Award (NIH F32). He conducted his postdoctoral research on the biomechanics of cardiac valves. Dr. Amini has served as an assistant professor in the Department of Biomedical Engineering at The University of Akron since August 2013. The overall goal of his research laboratory is to improve human health by studying the multi-scale biomechanics and biotransport in cardiovascular, ocular, and digestive systems. Dr. Amini's research has been funded by the National Science Foundation, Akron Children's Hospital, Firestone Foundation, and American Heart Association.

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Introduction

Office hours have long existed as a tool to provide instructor-student interaction, and to help students ask their questions outside of the class timeframe. In large-size college classes, using emails and online office hours have been introduced as effective substitutions for face-to-face office hours [1-4]. Moreover, cooperative learning has repeatedly proven to have positive impacts on students' educational experience [3,5]. Cooperative learning, which can be incorporated in classes of any size, enables students to improve their social and team-working skills. In addition, cooperative learning provides an opportunity for students to discuss their questions and overcome challenges within their groups without forming long lines outside the instructor's office during office hours.

Nevertheless, for certain technical courses in engineering curriculum, cooperative learning methods and similar approaches may not be applicable. For example, in preliminary programming courses, students should practice coding individually and work on the assignments outside a group setup to obtain a practical understanding of the material and improve their programming mindset and efficiency. Many students, especially those who lack self-confidence in mathematics- and programming-oriented courses, may not be inclined to ask their "basic" questions in the class. For similar reasons, they may simply not show up during the office hours. Since face-to-face office hours are expected to provide a more personal (and hopefully comfortable) environment for students to ask their questions, we investigated the benefits and disadvantages of requiring students to attend "mandatory office hours" in students' learning experience.

Methods

In our sophomore level Biomedical Computing course (4800:220), we incorporated the idea of mandatory office hours. We investigated the outcomes of this approach on students' performance and their understanding of the material. In this course, students' overall understanding of the fundamentals of programming in MATLAB® is evaluated using an open-book Pass/Fail exam (Exam 1) at the fifth week of the semester. Students who do not manage to obtain a "Pass" grade in this exam are given the chance of a retake exam. The retake exam takes place two weeks after Exam 1 at the same time for all students who would like to take this exam. Exam 2 given almost 6 weeks after Exam 1 evaluates the understanding of the students in more professional and biomedical-oriented applications of programming. Ultimately, the cumulative final exam addresses a comprehensive range of programming skills with specific concentration on biomedical applications. It should be noted that all exams given throughout the semester are designed with the same overall level of difficulty and challenge with respect to the covered topics. This is ensured, to the best of our knowledge, by designing the exam problems based on a combination of relevant assignment problems yet in a new context.

Upon making the observations listed in the following section, we required students who failed Exam 1 to attend mandatory face-to-face office hours -once per week, up until the scheduled retake exam- with the course instructor. The students were informed that not attending the office hours will result in a 10% deduction in their following homework assignment grades; while depending on the level of participation during the office hour, they would receive from 0% to 10% bonus points on the same assignments. Students who passed Exam 1 were also encouraged to attend office hours; however, attendance was not mandatory for them and did not affect their grades in either forms of bonus or deducted points. Using a free online appointment scheduler (<http://calendly.com>), students were able to see posted available times of the instructor as 10-minute sessions, and make an appointment based on their own schedule and time preference. This service would automatically add the appointment to both the instructor's and the student's calendar, and would save a significant amount of time by avoiding multiple emails for finding the perfect meeting time. Students were encouraged to make an appointment for two consecutive 10-minute sessions if they believed that they required more time. Furthermore, they were encouraged to contact the instructor for a separate appointment if none of the posted available times worked with their schedule. For this class with a total of 22 enrolled students, the instructor provided four time blocks of 1.5-hour office hours per week for two weeks. These hours were distributed throughout the week both in the mornings and afternoons to ensure that all students with different weekly schedules could find appropriate meeting times. Upon the completion of mandatory office hours two-week period, the posted available times for the instructor's office hours were limited to four 1-hour time blocks distributed throughout the week.

Results and Discussion

In spite of an average grade of 85 in the five submitted assignments prior to Exam 1, the average grade in Exam 1 was 67.4, with 12 students having a "Fail" grade. Prior to making any conclusions it should be noted that:

- 1- The level of difficulty of the test was similar, if not easier, than the assignments.
- 2- Only a couple of students had complaints about running out of time during the test, while interestingly enough, no student stated that the test was "too difficult" or "unfair".
- 3- The main common mistakes within this test were pertaining to the most basic and fundamental material covered in the class, which was unexpected given the individual assignment grades.
- 4- In an anonymous survey given a week prior to the exam, almost all students were content with the teaching style and explanation of the material in the class.

Prior to the implementation of this policy, the two graduate student TAs reported little to no attendance of students during their office hours. Additionally, the course instructor reported a total of 3 office hour appointments scheduled throughout the first 5 weeks of the class. However, starting upon the completion of the two weeks of mandatory office hours, an approximate of 9 and 13 students availed themselves of the instructor's and the TAs' office hours, respectively, on a regular basis until the end of the semester. Initially, this approach demonstrated acceptable success as the students' performance during in-class exercises noticeably improved. Of note is that three students including two who had failed in Exam 1 withdrew from the class along the semester, and were removed from the data set for the purpose of statistical analyses. Although the course material became increasingly more challenging toward the end of the semester,

statistically significant improvements (paired t-test, $\alpha=0.05$) were observed in students' grades between Exam 1 (mean=67.4 out of 100, n=19) and Exam 2 (mean=79.1 out of 100, n=19), as well as Exam 1 and the cumulative final exam (mean= 78.13 out of 100, n=19), with p-values of 0.002 and 0.004, respectively. Kolmogorov-Smirnov normality test was conducted to confirm the normal distribution of the grades in all three exams (p-value>0.15). A repeated measures two-way analysis of variance (ANOVA) yielded significant difference in students' grades between the three exams (p-value=0.001). A post hoc Tukey test conducted on the foregoing analysis revealed significant differences between grades in Exam 1 and Exam 2, as well as Exam 1 and the final exam for those students who had "failed" Exam 1. Interestingly, no significant difference was observed within the same comparisons for those students who had "passed" Exam 1. Moreover, a paired t-test revealed a statistically significant improvement (p-value=0.008) in Exam 1 retake grades compared with Exam 1 grades of those who had failed Exam 1 (n=10).

Modifying studying methods and having a "reality check" by doing poorly on Exam 1 are potential reasons behind the observed significant improvement throughout the semester for those who had failed Exam 1. However, there is no doubt that office hours -with instructor and/or TAs- facilitates the realization of such modifications for those students who struggle with course material. A refined study design which includes a control group (mandatory vs. optional attendance in office hours) would enhance the reliability of the conclusions. However, further details must be considered in such study since there may be adverse psychological effects in requiring only some of the students to mandatorily attend office hours while not requiring attendance for their peers with the same grade category.

Graduate student TAs reported that students mostly attended their office hours for "clarification" purposes or asking questions regarding their prepared computer programs for assignments. However, instructor's office hours were mostly attended with students having more fundamental questions and those who needed to go through a topic in more details. As such, the simultaneous availability of the instructor's and the TAs' office hours benefited students in a complementary manner. Moreover, a welcoming and encouraging behavior of the instructor was adopted to hopefully make the first mandatory office hour serve as an "icebreaker". Consequently, in most cases, students -even those with a lack of self-confidence- seemed to be motivated to attend individual office hours with the instructor and asked their questions with less reservation. These meetings provided an enhanced learning experience for students of all levels. On the other hand, an individual meeting with the instructor ensured individual attention and addressed each student's questions in the most effective and individual-specific way.

Mandatory office hours would take a noticeable amount of instructor's time during the period of holding this policy. However, the duration and the details of implementing this approach can be tailored by the instructor based on the class size, class level, and/or course syllabus. In larger classes or in cases where the instructor teaches several courses per semester, individual office hour meetings may not be quite feasible. Alternatively, the instructor may divide the students in groups of 3 or 4, based on their performance in previous assignments and/or exams, and require them to attend mandatory office hours in groups. Consequently, the integration of this method with cooperative learning techniques would potentially maintain the foregoing benefits, while taking far less amount of time from the instructor.

According to the course evaluation results collected at the end of the semester, a mean score of 4.65 (out of 5) for the instructor's "availability for office hours and appointments", and a mean score of 4.706 (out of 5) for the instructor's "concern for students' development and learning" are other proofs of success for this method from students' perspective. Some of the students' comments from course evaluation highlighted below further demonstrate the success of this method from the students' perspective:

- "I wish I could give more than a 5 under availability for office hours and appointments. He set a ton of his week open for office hours, gave us a website to apply for appointments, and was generally very ready to chat with students and further explain concepts and homework."
- "Office hours were a great way to try to understand the material. Professor was willing to hold office hours."
- "office hours were very accessible"
- "Appreciate my instructor always being available to receive extra help from"

Conclusion

We believe incorporating "mandatory office hours" technique, even for the first few weeks of the semester, would be advantageous, as it lays the groundwork for a thriving student-instructor interaction, and encourages students not to hesitate in reaching out for help. The details of this method can be customized by the instructor to suit any class size and/or course syllabus. Moreover, the combination of this approach with other online tools, active learning methods, and cooperative learning techniques could synergistically enhance students' learning experience.

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