Increasing Participation in Late-Afternoon Friday Lectures: How Variation in Incentive Techniques Affect Attendance

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Abstract

Lecture attendance in engineering classes is critical for improving grades, developing a fundamental understanding of material, and bettering social bonds [1], [2]. Late-afternoon Friday lectures often experience a decrease in attendance and this decrease can have negative effects on student success [3]. Therefore, the primary objective of this work was to increase Friday attendance in a senior level, required Mechanical Engineering (ME) class. This was done by introducing a Friday lecture schedule that had three rotating incentives on Fridays: in-person quizzes with a lecture, in-person group work/homework sessions and a lecture, and a synchronous, Zoom lecture (not in-person). Attendance data were taken each lecture in this class and in two non-consecutive weeks in two other ME classes that ran the same days and times. It was found that not only was attendance higher in this class than the two 'control' classes, but the type of incentive played a significant role: quiz days were the best attended, followed by Zoom, and finally by homework sessions. This was likely due to two variables: the direct impact on the students' grade and the effort required to attend lecture. Lectures with homework/groupwork required students to go to campus and saw a minimal direct link to their grade, whereas quizzes had an immediate effect on the grade and Zoom lectures were easy to attend. Additionally, students were surveyed to understand their perceptions of the rotating schedule. Overall, students enjoyed the flexibility that the schedule gave them and most liked the incentives that were offered to them. This work has the potential to influence how faculty can structure late-afternoon classes to achieve higher attendance, which can have a lasting impact on grades, habits, socialization, and student success.

Introduction

Class attendance plays a significant role in a student's grades, their ability to comprehend material, and their ability to foster peer connections [4], [5]. Late afternoon lectures often experience a decline in attendance, especially as the semester continues [4]. Friday lectures are particularly sparce due to a range of reasons including illness, traveling for a long weekend, attending sporting events, celebrating religious holidays, or even just spending time with friends [3]. Since many classes are offered on a Monday/Wednesday/Friday schedule, some students may miss up to a third of their lectures, which can have detrimental effects on performance and education. Researchers found that in engineering disciplines alone, Friday attendance alone plays a significant role in the overall performance of a student [6]. Therefore, incentivizing participation and attendance in Friday classes can play a critical role in better educating future engineers.

The incentive for attending must be greater than the temptation to be absent. There are many ways to motivate students to attend late-afternoon Friday classes. One way is through a mandatory attendance policy, where attendance contributes to a student's grade. Another way is to lower the bar for attending, usually through asynchronous or synchronous, online modalities like Zoom. Allowing students to attend virtually may allow them to keep their plans, but still attend class. Another way to incentivize students is to give quizzes or exams on Friday so that being absent directly impacts their grade. Other ways to motivate students are to increase social pressure through the use of group work or to do homework problems together. Working in groups or as a class has also shown to have a positive impact on overall grades [7].

Unfortunately, nearly all incentive techniques have drawbacks that make them difficult to use repeatedly. Mandatory attendance policies have shown a negative correlation with material understanding, as students can often be present in class without engaging in learning [8], [9]. Virtual classes have had a mixed effect on learning with some finding that virtual classes increase students' interest in a subject, while some have found a decrease in material understanding [10], [11]. Additionally, repeated virtual classes can lead to "Zoom Fatigue", which often leads to learning loss [2]. The other incentives, like group work or exams, also have drawbacks. They can put more strain on instructors and can take away from the amount of lecture time marked for learning new material. Finally, the efficacy of different incentive techniques has not been adequately measured.

Therefore, the primary objective of this study was to determine if Friday attendance can be increased in a senior level, mechanical engineering class using a combination of three approaches to incentivization.

Methods

A novel Friday teaching schedule was introduced for a senior level, mechanical engineering Control Systems (CS) class. Friday lectures rotated between 1) in person quiz with lecture (Q), 2) in person homework study session where the instructor helped students work on assigned homework problems (HW), and 3) synchronous, virtual lecture over Zoom (Z). For Z lectures, students could earn bonus points towards quizzes by answering poll questions- if the student attended each Z lecture and answered all poll questions, they would recoup one quiz grade (worth 5%). Monday and Wednesday classes were standard lectures (unless an exam or quiz was scheduled). This schedule was chosen for its potential to incentivize students to attend class,

while not succumbing to the challenges with each incentive technique (e.g. having Zoom lectures may lead to fatigue and loss of learning or too many quizzes may lead to loss of material presented to the students). It was hypothesized that all incentive techniques would increase attendance on Fridays. Ideally, Friday attendance would match Monday and Wednesday. However, it was also hypothesized that the type of incentive would play a significant role. Since quizzes played the most direct role in the students' grade, quizzes would be the most attended. However, because homework lectures had the least direct role in the grade and still required students to travel to campus, it was hypothesized that they would be the least attended. Therefore, it was thought that Zoom lectures would be somewhere in the middle.

The class of focus was control systems CS, which met three times a week (Monday, Wednesday, and Friday) from 4:10 - 5:00 pm on the university's campus during the fall semester. The lecture had 34 students enrolled. Raw attendance numbers were collected for all lectures throughout the semester in CS and 'control' data were collected in two other classes: mechanical vibrations (MV) and aerospace propulsion (AP). Data were collected for these two classes for two weeks in the semester. These classes were chosen because they were senior level and ran at the same time and days as CS. However, they were not perfect controls. While MV was a required course, it had another section of the class run in the middle of the day and AP was an elective that did not have an alternative section. Notably, MV's other section was taught by the same professor, which will be discussed later. More details can be found below (Table 1).

Table 1**.** Class descriptions. There was one primary class subjected to the rotating Friday schedule (CS). The other two classes were used as controls, and had standard lecture schedules, each with well-respected professors.

Class	Enrollment	Type	Other Section?	Attendance Collection Period
Control Systems (CS)	34	Required	Yes. Different professor, different time	Every lecture
Mechanical Vibrations (MV)	34	Required	Yes. Same professor, different time	Two, non-consecutive weeks
Aerospace Propulsion (AP)	52	Elective	No	Two, non-consecutive weeks

Statistical analyses were performed to determine the efficacy of the incentivization techniques on attendance (using the raw attendance values collected). A multiple comparison ANOVA was performed on the CS attendance data to determine if there were significant differences between Monday, Wednesday, and Friday. Additionally, t-tests were performed within the Friday data to determine which incentive type (HW, Q, or Z) had the greatest effect on attendance. For all analyses, the significance cutoff was $p \leq 0.05$ and $p \leq 0.01$ was considered highly significant. These results will be discussed in the attendance portion of the results.

In addition to the raw attendance data, a survey was conducted to determine the student perceptions of the Friday lecture style (Appendix A). Questions 1-5 were Likert-style questions that asked students how likely they were to attend lectures (Monday, Wednesday, and the

different Friday types). Question 6 asked them what their most recent midterm exam grade was. Questions 7-9 were open ended questions about what students liked and disliked about the incentive types. The response to question 6 was used in conjunction with questions 1-5 to see if there was a connection between students' attendance and grade, which was done by calculating the Pearson correlation coefficient between two variables.

Results and discussion: attendance

The raw attendance numbers collected for CS throughout the semester can be seen below (Figure 1).

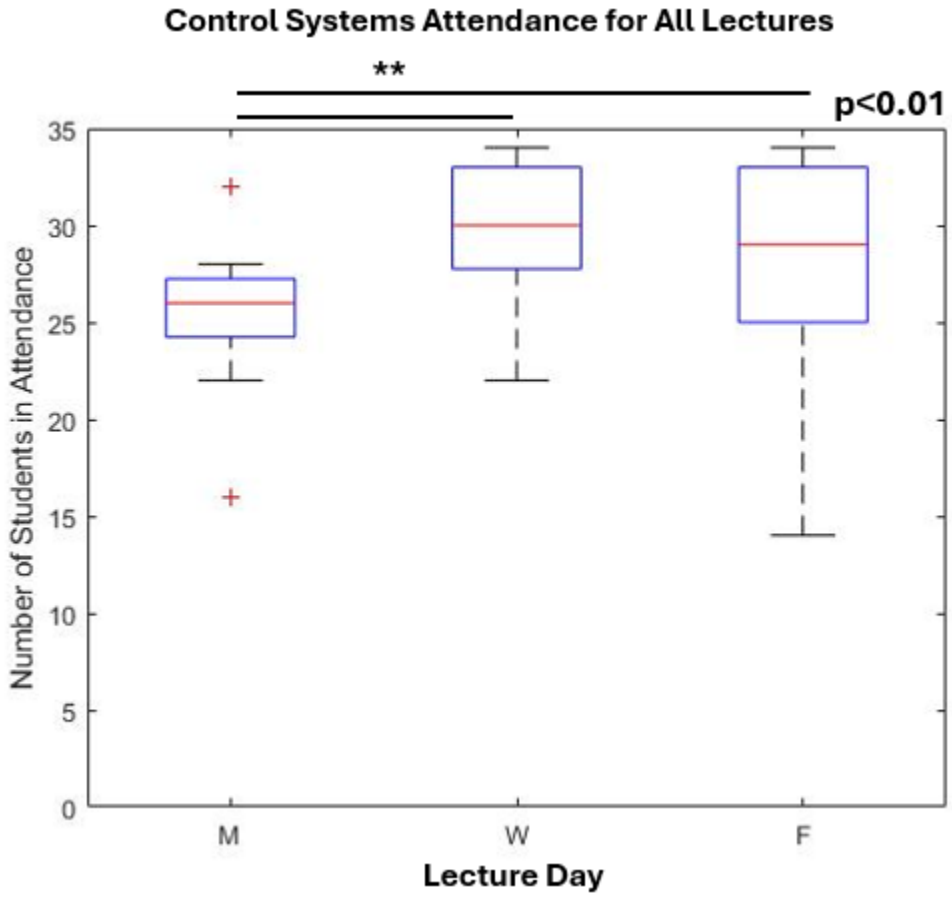

Figure 1. Boxplot of the raw attendance for CS (max=34) for Monday, Wednesday, and Friday. Boxes are bound by the first and third quartiles with the red line indicating the median. Black bars show the max and min values.

There was no significant difference between Wednesday and Friday ($p=0.11$), but Monday had significantly lower attendance than both Wednesday and Friday ($p<0.01$). Notably, Friday showed a larger standard deviation, suggesting the type of incentive influenced attendance as well (Figure 1).

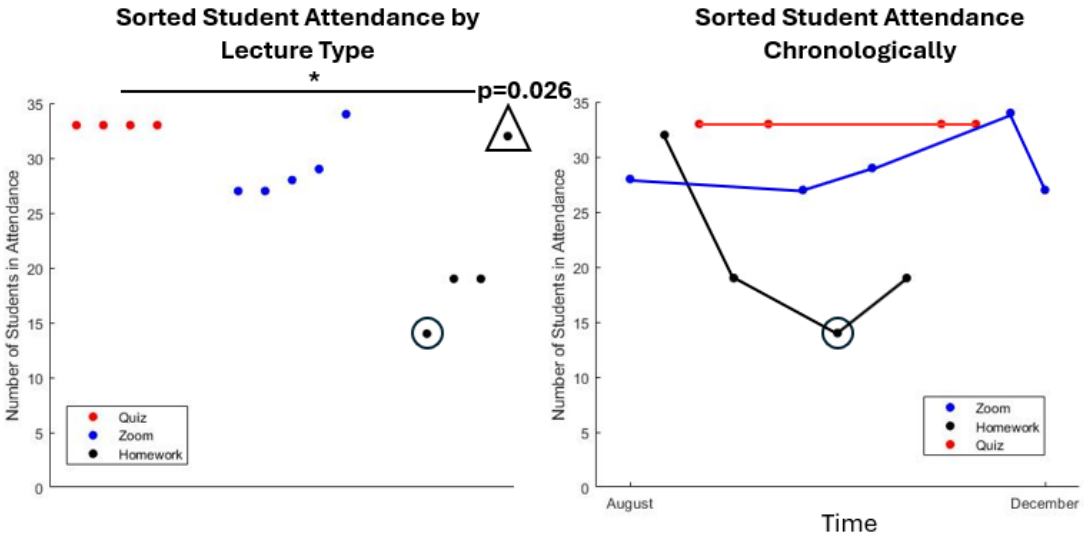

Figure 2. Scatterplot of Friday attendance. The same data are shown by incentive type, and in ascending order (left) and chronologically (right). The black circle represents the HW lecture with the lowest attendance: this was the only HW to not precede a quiz the following week. The black triangle represents the highest attended HW lecture: this was the first HW lecture. A single star indicates significance (0.05>p>0.01).

Analysis of Friday lecture attendance revealed a significant difference between homework (HW) and quiz (Q) sessions (p=0.026), with no significant differences among other comparisons. Attendance also shows quizzes had the highest attendance (only one absence per quiz), followed by Zoom (Z) lectures, with HW being the least attended (Figure 2, left). This trend aligned with the hypothesis that both grade impact and ease of access would drive attendance. A further indication that this may be true can be found in the chronological attendance data (Figure 2, right). The lowest attended HW lecture (Figure 2 right, black circle) was the only HW lecture not to directly precede a quiz in the Friday schedule. All other HW days were exactly one week before an anticipated quiz. This reinforces the hypothesis that students may have been primarily motivated by assessments; and when HW was too far removed from a quiz, students appeared to perceive less value in early practice. Conversely, the highest-attended HW lecture was the first of the semester, suggesting that students may have initially engaged before realizing HW lectures would have little direct impact on their grade.

A key outcome was the relative influence of grading weight versus physical attendance barriers. Quizzes, worth 5% of the total grade each, were the strongest motivator. HW, graded for completion and worth approximately 1.7% of the total grade, had lower attendance, despite being worth more than the Zoom lectures (worth about 1%). However, because Z lectures were easier to attend, students may have viewed the relative significance of HW to be less than Z. Overall, while incentives improved Friday attendance, a clear hierarchy emerged, with quizzes being most effective.

It was important to understand these data with respect to other senior level classes that ran at the same days and times. These outcomes were then compared to the other control classes, MV and AP. Figure 3 shows the data for the CS class in its entirety and the attendance for MV and AP during two, non-consecutive weeks of the semester (Figure 3).

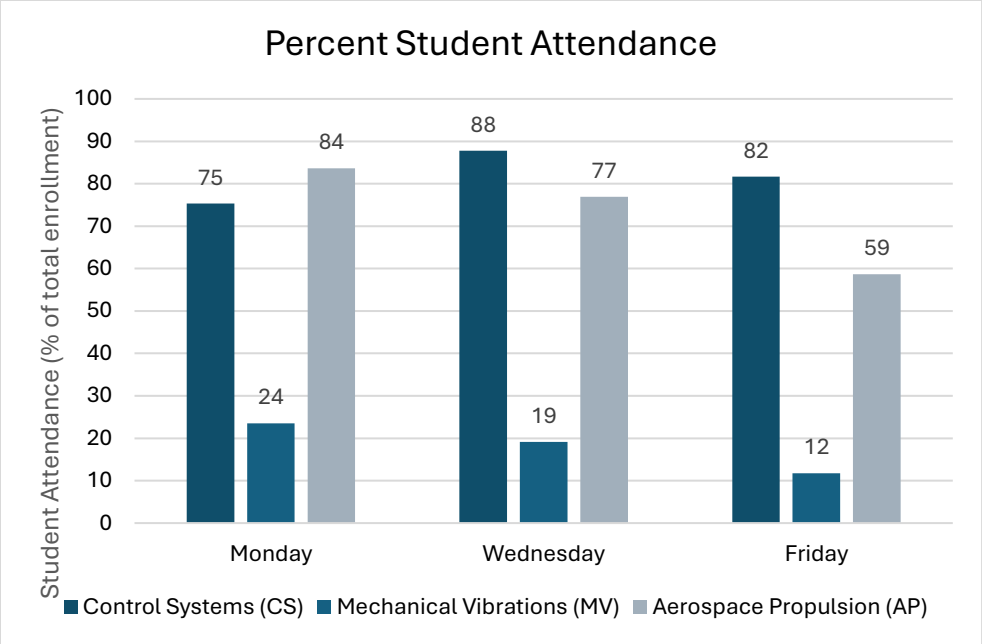

Figure 3**.** Student attendance (expressed in percentage of enrollment) for CS, MV, and AP. CS had the highest average attendance for Wednesday and Friday, whereas AP had the highest for Monday. MV had the lowest attendance over all three days.

The data from MV and AP reinforce information from the literature: there was a drop in attendance from Monday/Wednesday to Friday. AP dropped nearly 30 percentage points from its Monday-Wednesday average and MV nearly halved; CS did not drop at all.

One potential concern was that, by increasing Friday attendance through clear incentives, that students would instead skip Monday classes. However, using Wednesday and Friday averages as a baseline, Monday's attendance only dropped 10 percentage points. AP, which had more similarities to CS, had a drop of 21.5 percentage points between its Monday-Wednesday average and Friday. This suggests that the incentives effectively increased Friday attendance without simply displacing absences to Monday.

There were three other notable points from the other control classes. The first was the uncharacteristically low attendance in MV. This was likely because the instructor also taught a different section of the course much earlier in the day, meaning that students who could not enroll in that section due to size limitations, went to the other section. Another interesting point was the attendance difference between AP and CS. AP was an elective course and CS was a required course. Electives tend to be better attended than required courses, but that was not the case here. This suggests that the boost in Friday attendance may have had a reinforcement effect, encouraging students to develop a habit of attending class on other days. The last point had to do with the students that were enrolled in CS class investigated in this study. Since there was an earlier section of CS, it was feared that section might be 'more desirable' and that the 4:10 pm section would have less responsible students who did not sign up in time for the earlier section. It does not seem as though that variable affected the outcome, as attendance was higher on Friday, but may be something to track in the future.

Results and discussion: survey

Of the 34 possible student responses, 31 students responded to the survey with all the necessary information. The survey data was used to determine whether increased attendance correlated with better grades. Responses to Q3-5 (likelihood of attending different Friday lectures) were compared with Q6 (midterm grade) to identify potential connections. Nearly all students (30 of 31) reported being very likely to attend Q lectures, while 23 were likely or very likely to attend Z lectures; both of which aligned with the raw attendance data collected throughout the semester and discussed earlier. Given this high attendance, it was difficult to assess a correlation between grades and attendance for Q or Z lectures. However, HW lecture attendance showed greater variability (Figure 4), providing more insight on trends.

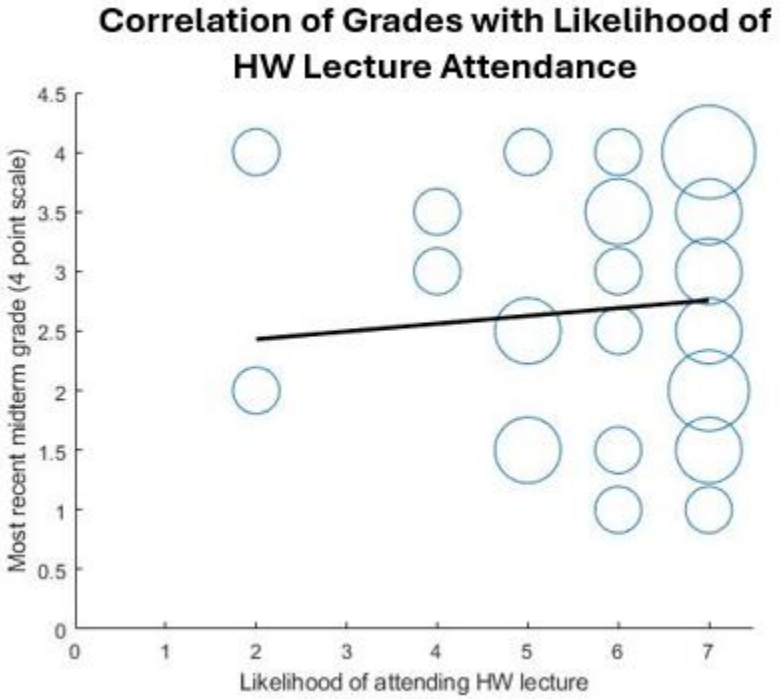

Figure 4**.** Correlation of midterm grades with self-reported likelihood of attending HW lectures. Larger circles indicate more students at any given likelihood and grade. Black line is trendline between HW lecture attendance likelihood and most recent midterm grade.

The average and mode likelihoods to attend a HW lecture was a 6 (likely) and 7 (very likely), respectively, but the standard deviation was higher compared to the other lecture types (S.D.=1.2). There was a small, positive, non-significant correlation between HW attendance likelihood and midterm grade (Pearson correlation coefficient = 0.0147, $p = 0.40$). There were anomalies on either end of the spectrum: students who were neutral or not likely to attend HW lectures ($\leq$4 on Likert scale) but still did well on exams, and students who were likely to attend ($\geq$6), but did not do well on the exam. The former may be explained by students who had already completed the homework and were confident they could learn the lecture material on their own. The latter could be explained by students who wanted to shortcut the learning process by getting access to homework solutions. Regardless, because of the distribution, the strength of the

relationship between grades and HW lecture attendance or if the two are just confounded with students who are already likely to attend Friday lectures.

The last research questions that could be investigated with the qualitative data surrounded the student perceptions of the rotating schedule. When asked what they liked about it, 52% of students made comments about being remote. Many said they thought it was “convenient”, “nice to be at home”, and “allowed for travel” if they wanted. Other students mentioned that the schedule kept them accountable and they liked that they had a direct incentive to go, citing both quizzes and homework. When asked what they disliked, three students mentioned they did not like Friday quizzes, with one saying that administering quizzes as incentives is “more forcing rather than incentivizing” and another student saying they “check out usually around 3 pm on Fridays”. 77% of students either had 1) no complaints at all or 2) suggested posting the schedule in the syllabus. This was a reasonable complaint as the Friday schedule was only discussed in class and was determined about three weeks in advance, so making plans for a Zoom lecture a month out was not possible. However, these students did not dislike the idea of the rotating schedule itself. Overall, students liked that there was a unique schedule that allowed for greater flexibility, while also incentivizing students to attend lectures.

Conclusions

This study investigated the efficacy of a Friday lecture schedule with rotating incentive formats in a senior level, mechanical engineering class. This study showed that attendance in the class with the rotating incentives for Friday attendance was consistently higher than that of the control courses. The type of incentive played a key role in the attendance, where interventions that directly affected their grade (quizzes) or facilitated remote attendance that was easier to attend (Zoom lectures) had the highest attendance. Activities that had low grade impact and were on campus (HW lectures) were least attended. Student feedback was generally positive, highlighting both the benefits of incentives and the convenience or remote participation. This work also highlighted that the timing and management of the class may play a key role in increasing attendance. This was indicated by the fact that HW lectures were best attended when they directly preceded a quiz, instead of a Zoom lecture. Overall, the findings suggest that a well-structured incentive system can effectively enhance attendance while maintaining instructional flexibility.

Instructor thoughts

From an instructor point of view, it was more work to constantly prepare different types of materials (Zoom versus in person), complete homework sets well in advance (as a first-time instructor, I came up with many of my own examples), and grade more (primarily quizzes). However, I believe that it was well worth the effort: I was able to optimize the number of Zoom lectures to limit “Zoom fatigue” and administer enough quizzes to have an idea of my class’ understanding, while still being able to cover all the content I needed. On top of increasing attendance, I also learned how to optimize the schedule for the future, as previously discussed with the importance of when to schedule certain Friday lectures.

Limitations and future work

There were a few limitations to this work that could be solved in future work. The first was that the control groups for this study were imperfect: one was an elective taught with no alternative

professor and the other was a core class that had a different section with the same professor. In the future, data could be collected with the same CS class that runs at 4:10 pm but does not have the rotating Friday schedule or the rotating schedule could include a standard lecture in the rotation. Another drawback was that all attendance data were raw headcounts. Without some form of identifier, it is difficult to say anything about the history of the students (grades or attendance) outside of this one class. This could be solved by keeping track of each student (attendance and grade) to better understand correlations between the two variables. The final limitation was related to the relationship between attendance and grades. There are many variables that play a role in a student's grades, and because previous academic standing was not able to be obtained, it was difficult to determine if there was a causal relationship. In the future, HW lecture attendance could be paired with an outcome measure that is more indicative of fundamental understanding of the material, such as graded homework problems.

Impact

This work has the potential to influence how late-afternoon Friday classes are taught to increase attendance, which can in turn increase grades, material understanding, and socialization. This may even lead to an increase in attendance across all days of the week, having a lasting impact on the habits of future engineers.

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Appendix A

1) Rate how likely you are to attend a Monday lecture.

1- Very Unlikely	2- Unlikely	3- Somewhat Unlikely	4- Neutral	5- Somewhat Likely	6- Likely	7- Very Likely

2) Rate how likely you are to attend a Wednesday lecture.

1- Very Unlikely	2- Unlikely	3- Somewhat Unlikely	4- Neutral	5- Somewhat Likely	6- Likely	7- Very Likely

3) Rate how likely you are to attend a Friday Zoom lecture.

1- Very Unlikely	2- Unlikely	3- Somewhat Unlikely	4- Neutral	5- Somewhat Likely	6- Likely	7- Very Likely

4) Rate how likely you are to attend a Friday lecture with homework examples.

1- Very Unlikely	2- Unlikely	3- Somewhat Unlikely	4- Neutral	5- Somewhat Likely	6- Likely	7- Very Likely

5) Rate how likely you are to attend a Friday lecture with a quiz.

1- Very Unlikely	2- Unlikely	3- Somewhat Unlikely	4- Neutral	5- Somewhat Likely	6- Likely	7- Very Likely

6) Which grade did you receive on the most recent midterm?

1.0 or less	1.5	2.0	2.5	3.0	3.5	4.0

7) In your own words, what is your opinion of the structure of the course, specifically with Friday classes?

_____

_____

_____

_____

8) What do you like about the alternating Friday schedule?

_____

_____

9) What do you dislike about the alternating Friday schedule?

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