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Exploring the Impact of Class Start Times on Student Engagement and Academic Performance in Second-Year Engineering Courses

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Abstract

When it comes to education at the college level, class scheduling is an important consideration. The time of day a class is scheduled for can impact various components of the learning environment, such as levels of student engagement, student performance in the course, and student ratings of the class. Understanding the implications of class time in engineering could be a significant factor in improving student success rates. In the current study, the implications of start time on student engagement, student perceptions, and academic performance in two second year public engineering courses are investigated.
This study includes data from multiple semesters of each course during which the classes have been offered at varying times between 8:30 am and 1:55 pm. The course content and structure have remained consistent across the semesters. Department logistics determined the scheduling variations and created an opportunity to analyze the relationship between class start time and student outcomes. This project will address three research questions:

1. How does class start time affect student engagement?
2. Is there a difference in student academic performance when considering the time the course is offered?

A comparative analysis will be used to analyze data from two different engineering courses; one is an engineering design course, and the other is an engineering mechanics course. The data includes attendance records, student participation measures, academic performance (like final grades), and course evaluations collected across multiple semesters. A correlation will be performed to determine the relationship between class start times and student engagement, participation, and academic outcomes.

Through this analysis, the study aims to identify how class start times affect student behavior and performance in engineering courses. The findings of this research study can help inform classroom design based on the time a class is offered, and they have the potential to inform scheduling decisions that can improve student engagement and learning outcomes.

Introduction

In colleges, educators usually teach distinct courses, sections, and schedules across various semesters, with varying class time or semester preference. Some educators do teach year-round, while others have but one teaching assignment throughout a fall or spring semester during an academic year. Among those teaching year-round, preferred teaching time may lean toward Fall,

Spring, or even summer due to the flexibility in different teaching modalities and the student population who take the course based on the semester. In addition to semester preference, faculty may have a preferred teaching time that can also affect the type of student population that takes the course or the design of the activities based on timing. While faculty have their preferences and may have some say on when their course is offered, the students also have their own preferences used when selecting their classes based on both the time and semester it is offered. Class timing could be an important consideration to include when creating course schedules for academic programs.

Anecdotally, it was experienced that switching a course previously offered mid-morning or early afternoon to an early morning time slot resulted in decreased engagement from the class. During the early morning class offering, the students remained disengaged despite the instructors' efforts to energize students through engaging discussions, repeated explanations of topics, and providing supplementary short videos. These course activities had successfully been used in the other offerings of the course, but the students in the early morning section had a different response. Based on this experience, a research study was conducted to explore whether class time correlates with student engagement in the course and student academic performance. To mitigate instructor bias, the study was a collaborative effort between two faculty members teaching different second-year engineering courses, an engineering design course, and an engineering mechanics course. The results of the study will identify some of the effects of class timing on a learning environment, including student engagement, performance, and overall student outcomes.

Literature review

There are many ways to measure student engagement within a course, and a common way is through Attendance. Class attendance is often a critical requirement, specifically for in person course offerings, but after the onset of the pandemic almost 5 years ago the global education landscape was thrust into a "new normal [1]," prompting a swift transition to Emergency Remote Instruction (ERI).

This transition produced great results for many aspects of education, including instructors creating new teaching materials and adopting new teaching styles to meet the needs of the online environment. Conversely, this experience also shifted student perspectives on attending class and their ability to get course material, which they could often find from asynchronous sources that were now provided by the instructor. This experience challenged the traditional perception that links attendance to student performance. This relationship is currently evolving, but there have been many studies that highlight a correlation between attendance and academic achievement [2-4]. The switch back to regular, in-person classes has had a shift in student attendance compared to pre-pandemic times and on the level of student interaction during class time.

For this study, the two included courses are both in-person classes that require Attendance as part of the course grade. The courses are offered at various times throughout the day during different semesters, and the researchers will explore if the timing of the class has an impact on student attendance. Past studies show that students who attend morning classes perform better than students who attend afternoon classes. Research gives mixed evidence on how school start times influence academic performance. Some studies show that delayed start times, shifted by some 50 minutes, help improve academic performance, with evidence establishing that students may perform better in the afternoon[5]. Other studies show that morning classes are more likely to exceed their later peers in academic performance [6].

This indicates a potential correlation between class timing and academic outcomes. For example, one study examined this with third-year Bachelor of Science in Information Technology students and concluded that when class met, especially in the morning, impacted student performance[7, 8]. There were additional variables, such as gender, major, Instructor, and term, that acted as contributing variables[9].

This current study builds upon these findings to further examine class time impacts on student engagement for two second-year engineering courses.

Research Methods

This study analyzes data from multiple semesters of two second year engineering courses, a mechanics course, and a design course, where across the semesters the courses were scheduled at varying times between 8:30 am and 1:55 pm. The courses did not vary in content or structure from semester to semester, and differences in scheduling were driven by departmental logistics. This created a circumstance where the effect of class start time on student performance could be explored.

In this study, we conducted a descriptive statistical analysis to explore the effect of class time on student attendance and performance. The study includes four semesters of data for each course, with multiple course sections offered during each semester. The instructors kept track of Attendance for each of the courses during the 15-week semesters and used this data with the final course grade to explore the relationship between class time, Attendance, and performance.

Site and Participants

Both courses are offered at the University of Florida. The engineering design course includes data from 175 undergraduate students, primarily declared civil engineering majors who are taking the course during their second or third year. For the design course, data was used from the following four semesters: Spring 2023, Fall 2023, Spring 2024, and Fall 2024 semesters. There were two sections of the course offered in Spring 2023 and Fall 2023, and one section offered in Spring 2024 and Fall 2024. The course title is *Technical Drawing and Visualization,* and it is an

engineering course centered on teaching 2D and 3D design skills using AutoCAD [10]. The classes were conducted in person, with course materials shared through the LMS Canvas. The course includes learning 2D & 3D CAD skills along with hands-on visualization and drawing activities[11, 12]. The course consists of three lab assignments and three examinations that make up the majority of the grade.

The engineering mechanics course includes data from 448 undergraduate students who have declared majors that span all the engineering disciplines, in addition to a few students in agricultural science, the humanities, and business. The four semesters included in the data are: Fall 2022, Spring 2023, Fall 2023, and Spring 2024. The course had three sections offered during Fall 2022, Spring 2023, and Fall 2023, and had two sections offered during Spring 2024. The course title is *Engineering Mechanics – Statics*, and it is an engineering course focused on introducing students to equilibrium[13]. The classes were conducted in person, and all course materials were shared through the LMS Canvas site. The class periods were primarily active, problem-solving sessions with biweekly assessments evaluated using a mastery grading system [13]. Class attendance was strongly encouraged and tracked through participation points.

For each course, the class offerings between 8:30 am and 1:55 pm were included in the analysis. The breakdown of course times per course is given below in Table 1.

Table 1: Number of sections included at the different class times.

Course Time	Engineering Design Course	Engineering Mechanics Course
8:30 am	2 sections	2 sections
9:35 am	2 sections	2 sections
10:40 am	-	2 sections
11:45 am	-	3 sections
1:55 pm	2 sections	2 sections

Data Collection

The data obtained from the courses includes student performance in all aspects of the course, like assignments, exams, projects, and Attendance; however, for this study, only the attendance data and final course grades will be included. All data was de-identified to maintain confidentiality.

The design course consisted of two weekly class meetings, each lasting two hours, where the Attendance was recorded by the instructor at the end of each class session and documented on Canvas LMS. The mechanics course consisted of three weekly meetings, each 50 minutes long, where Attendance was recorded for each class period. The Attendance used in this analysis only includes the non-assessment class periods, as Attendance was almost always 100% for assessment class periods.

Student attendance was based on noting their presence during each class, but whether they were on time was not recorded. Academic performance is determined using the final grades assigned to the students in each of the two courses. The final grade is computed using all assignments, tests, and other course requirements based on each course's respective grading policy. For both courses, the students had access to all course materials on the LMS site to complete their assignments. However, the classroom presence was beneficial as the instructors could offer additional guidance and answer questions students had. The class time is helpful in providing students with learning support, completing assignments, fixing technical issues, and uncovering any misunderstandings from the students.

Data Analysis

The data collected for this study were organized, analyzed, and mapped using Excel. The data in the study were used to answer two questions. The first question is instruction:

1. How does class start time affect student engagement?

For Question 1, the analysis included six sections of the engineering design class and eleven sections of the engineering mechanics course. To identify trends in class time and Attendance, the attendance percentages for each semester were computed and then the distribution was plotted. There were five categories of attendance percentages used: <50% attendance, 50-70% attendance, 70-80% attendance, 80-90% attendance, and 90-100% attendance. The results for each class's Attendance are presented in Figure 1 and Figure 2. These figures illustrate attendance patterns across the different class times for each semester included. Figure 1 is the distribution for the engineering design class, while Figure 2 is the distribution for the engineering mechanics' class.

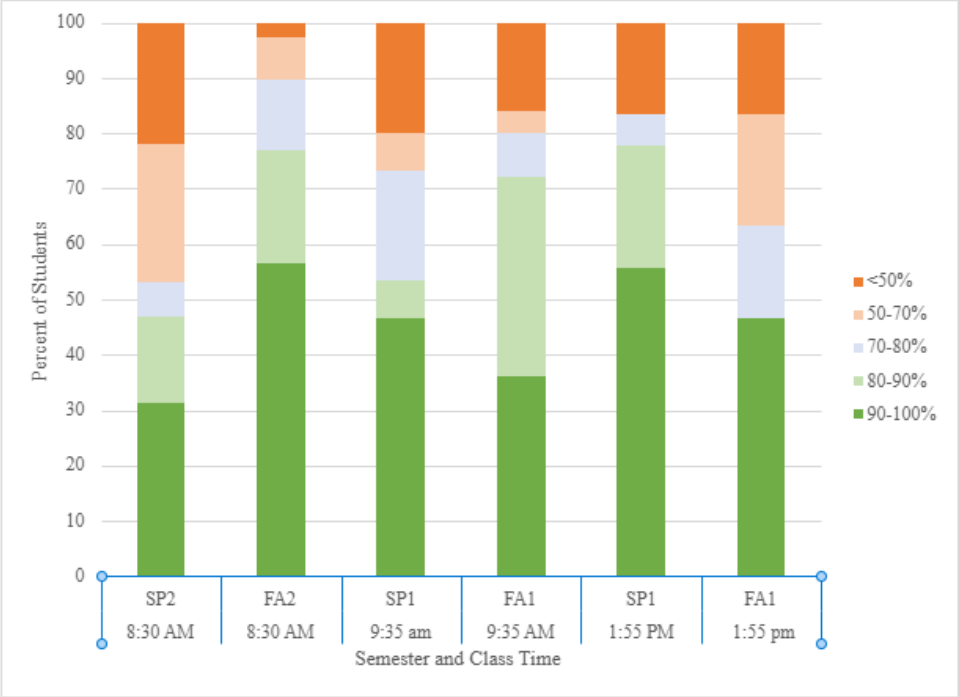

Figure 1: Engineering design class attendance per class time

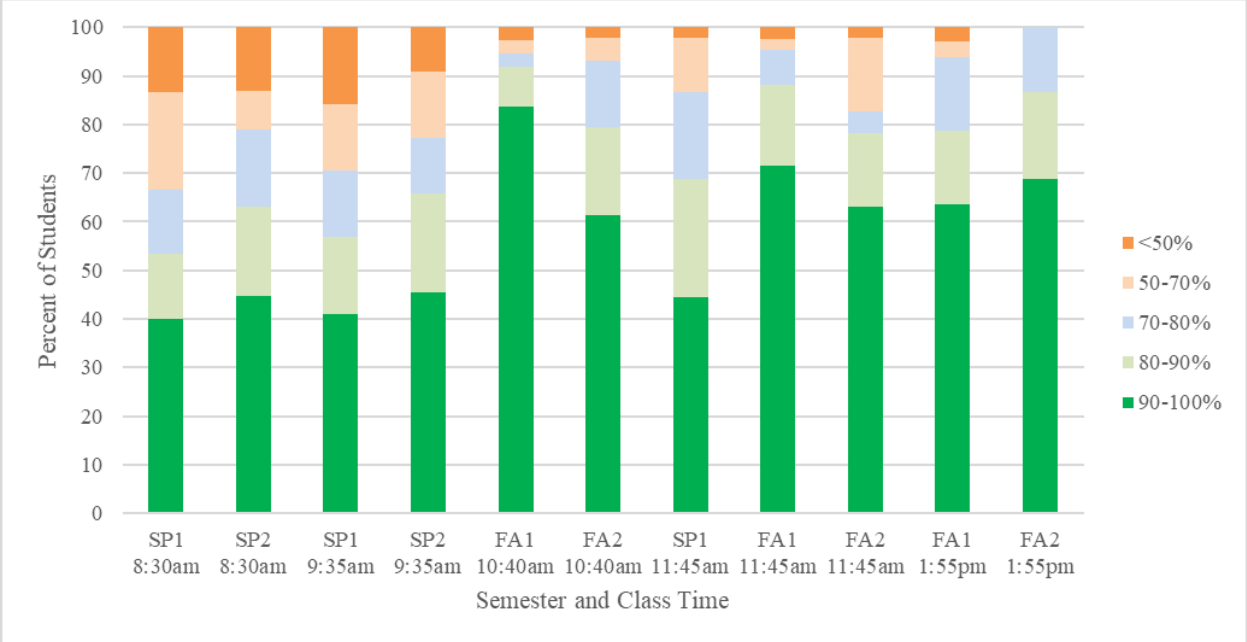

Figure 2: Engineering mechanics class attendance per class time

Figure 1 and Figure 2 have varying results amongst the two courses and across all the course times. The design class does not have a clear trend on Attendance between earlier and later class times with the lowest 90-100% attendance occurring during the SP2-8:30 am section and no percent of students attending 80-90% of the time during FA1-1:55pm. The engineering

mechanics course also has varying attendance results, but the later class times have higher attendance percentages with the exception of the SP1-11:45am semester.

The second question the study will look at is:

2. Is there a difference in student academic performance when considering the time the course is offered?

For Question 2, the data was analyzed for each of the sections from the four semesters to determine how academic performance is related to class time. The student's final grades were grouped into four categories based on the final grade earned in the course: A grades (including A and A- grades), B grades (including B+, B, and B- grades), C grades (including C+, C, and C- grades), and Failing grades (including all remaining grades). The results for the academic performance with regards to the class length are shown in Figure 3 for the design class and Figure 4 for the mechanic class. Figures 3 & 4 indicate the percentage of students for every different class length in these ranges of grades.

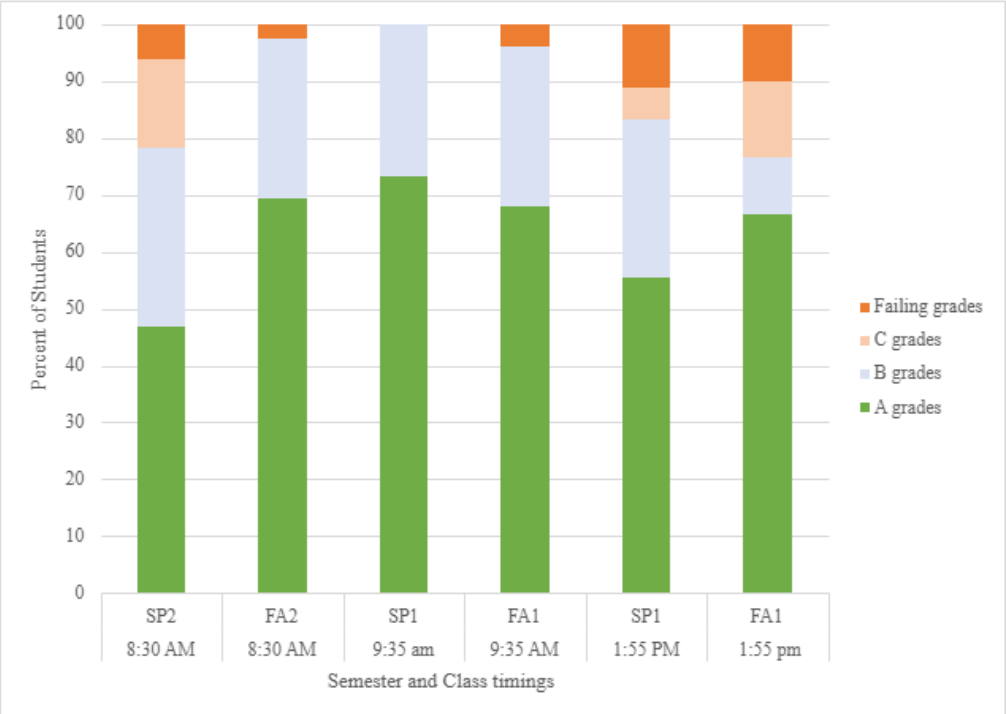

Figure 3: Engineering design final grades per class time

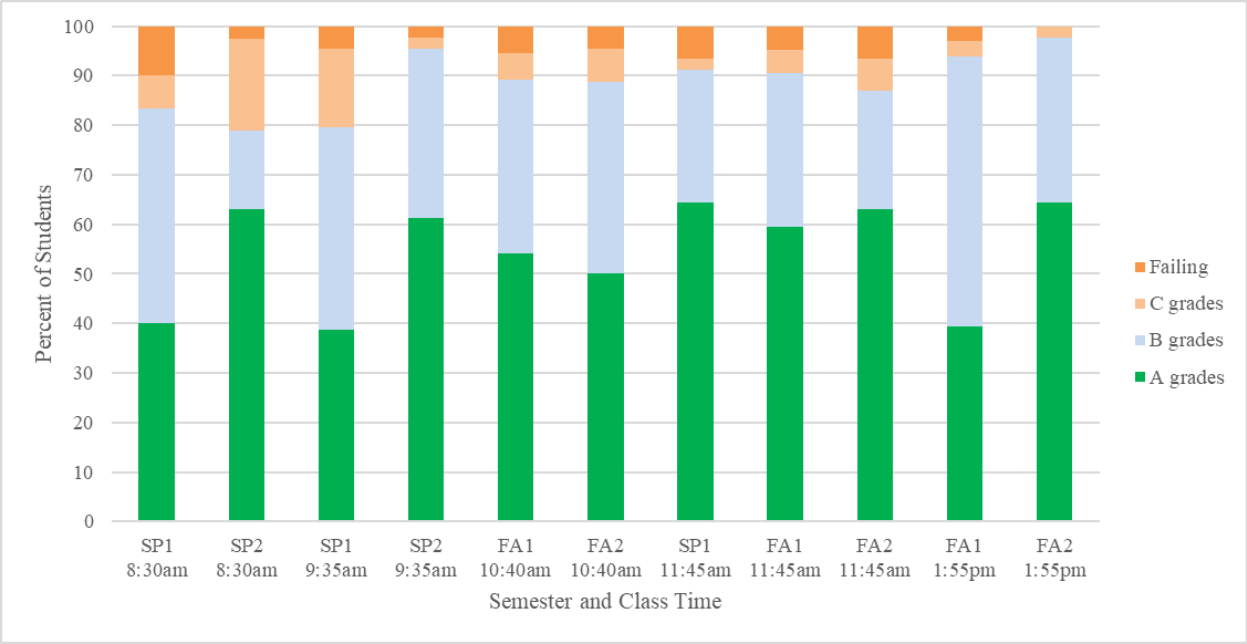

Figure 4: Engineering mechanics final grades per class time

Again, these graphs do not present a clear trend for academic performance based on the offering of class time. For the mechanics course, there are more C and failing grades during the earlier class times, but this does not result in more A grades during the later class times. The design course has the lowest percentage of A grades during one of the 8:30 am sections, but the other section along with several other course offerings have higher A grade percentages.

Results and Discussion

The first question investigated whether and to what extent student's class starting time influences the participation of students based on student attendance. Student attendance did not show any pattern with the changes in class starting times, yet there are nevertheless some interesting insights to be able to report.
For the design class:

- The 8:30 am class offerings of the design course also saw an increase in attendance between SP2 and FA2 offerings, when the number of students attending 90-100% increased over 20%.
- The other times for the design course had a drop in the 90-100% attendance category when comparing the spring semester to the fall semester for the same time the course is offered.
- When including the top two attendance categories (80-90% and 90-100%), the semesters with the best attendance were FA2-8:30 am, FA1-9:35 am, and SP1-1:55 pm.

For the mechanics course:

- The earlier morning sections of the mechanics course, including the 8:30 am and 9:35 am sections, had a consistent percentage of students attending 90-100% of the time. Around 41% of students were in this category.
- For these same early morning class times there was the most significant percent of students that attended <50% of the time
- The best attended class was FA1-10:40 am with other high attendance percentages occurring in FA2-10:40 am, FA1-11:45 am, FA2-11:45 am, FA1-1:55 pm, and FA2-1:55 pm. These all had 90-100% attendance for more than 60% of the students.
- A drop in attendance is noted for SP1-11:45 am compared to the other semesters that had the course offered at the same time.
- The FA2-1:55 pm section had no students attend the class less than 70% of the time for high engagement from all students.

From these results, there is not sufficient evidence to determine whether students generally prefer a certain class time, as the attendance ranges varied significantly between class time, semesters, and courses. The results also indicate that it would be valuable to investigate the difference between spring and fall semesters to see if there is a difference in student populations since there were often varying results between semesters at the same time.

The second research question investigated the relationship between time of class, if any, and academic achievement, specifically, the final grades received in each course. The significant results for each course are provided below.

listed below. For the design course

- The sections with the lowest percent of A grades were the SP2-8:30am section followed by the SP1-1:55pm section.
- There was a 20% increase in A grade earned between the two 8:30 am sections and a 10% increase in A grades between the two 1:55 pm sections.
- The section with the highest percentage of A grades was SP1-1:55 pm. This section only had A and B grades for the highest-grade average overall.
- The semesters with the fewest low grades, C grades, and failing grades were earlier time sections, including FA2-8:30 am, SP1-9:35 am, and FA1-9:35 am.
- The semesters with the most failing grades were both 1:55 pm classes, with almost 10% of the students failing.
- The FA1-1:55 pm had the smallest number of B grades earned.

For the mechanics course:

- There were several semesters with over 60% of the students earning A grades, including SP2-8:30 am, SP2-9:35 am, SP1-11:45 am, FA1-11:45 am, FA2-11:45 am, and FA2-1:55 pm.
- The semesters that had the lowest percent of A grades were SP1-8:30 am, SP1-9:35 am, and FA1-1:55 pm.
- The early morning and late afternoon classes (8:30 am, 9:35 am, and 1:55 pm) are not consistent amongst the percentage of A grades earned, but the 10:40 am and 11:45 am class times always had 50% or more of the students achieving an A.
- The sections with the lowest grades, C or failing grades, were both 8:30 am sections and SP1-9:35 am sections. The other 9:35 am section had a decrease of 10% in the number of students that earned C grades.

Based on these results for the final course grade, the design course had the highest percent of A grades for the 9:35 am section, and the mechanics course had the highest percent of A grades for the 10:40 am and 11:45 am sections. These times reflect students' preferred times for students or the times when their performance is highest during the day, as reflected in their course grades.

While not explicitly studied in this analysis, the comparison of the two figures for each course respectively can identify if there is a possible relationship between student attendance and academic performance. This could be identified if the semesters with the highest attendance correspond to the semesters with the most A grades. For the design course, interestingly, this relationship does not exist. The semester with the highest grades, SP1-9:35 am, is a semester that has lower attendance percentages. However, the semester with the worst attendance, SP2-8:30 am, did correlate with the lowest number of A grades earned. For the mechanics course, there is no relationship between attendance patterns and the final grade earned. While attendance was often better in the late morning and afternoon sections, the grade pattern did not follow a similar trend.

Conclusion

The class times showed variation in attendance and academic performance with no consistent relationship between the time of class and the effect on these two variables. The two different classes also had different trends when comparing the courses to each other, suggesting that the type of class is also important to consider in an analysis like this. For the design course, there is no general trend for attendance and class time with varying results for each section at the same time and the grades earned were also generally high with the exception of one 8:30am section The general trend for the mechanic's course can be summarized as attendance was at its lowest at 8:30 am and 9:35 am classes, with an increase in attendance for later course times, and academic performance was most consistent at 10:40 am and 11:45 am sections while being more variable in the early morning and afternoon sections. These findings suggest that class timing, course

type, and semester-specific factors may all contribute to variations in student engagement and performance identifying that class scheduling is complex process that can affect student outcomes.

Limitations and Future Work

This study was limited to only two courses with different course designs. For future research, the limitations could be addressed by including additional STEM courses that are also offered at different times of the day and expanding on the sample size of the courses included. It will also be important to explore the impact of varying student instructors and course designs on their course experience and engagement. In addition, the researchers may expand this area of research to other types of student engagement measures other than attendance frequency, such as assignment submission. This study was a valuable initial step to determine the relationship between class time and student outcomes with an opportunity to explore more variables and the impact that course timing has on that to determine if there are recommended times to offer certain course.

Acknowledgments

We used AI to correct grammar, check sentence formations, and improve the writing to assist the writing process.

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