

The Impact of In-person Instruction on Student Performance Using a STEM Technical Design Course

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Introduction

Since the onset of the COVID-19 pandemic in the Spring of 2020, there has been a complete shift in instructional modalities[1]. The pandemic prompted widespread closures and a rapid shift to remote learning, compelling instructors to adapt their course materials and teaching approaches. These changes included shifts from in-person instruction to Emergency Remote Instruction (ERI), online instruction, and eventually HyFlex mode, where minimal in-person attendance was combined with online learning. As the situation has evolved, many institutions have now transitioned back to in-person instruction, albeit with multiple precautions in place.

During this period, instructors have prioritized flexibility for students [2], providing course materials, including lecture videos, on learning management systems (LMS) such as Canvas [3].

While most instructors now provide course materials and recorded lectures online [4], making physical attendance redundant for students, it's worth noting that most students still prefer attending classes in person [5]. Despite the abundance of literature on the impact of attendance, there is still a need to understand the impact of attendance after the pandemic when course materials are available on learning management systems (LMS).

This study aims to bridge the existing gap in the literature by investigating the following questions:

1. Does in-person attendance have a significant impact on student performance?
2. Do students' presence in the classroom significantly affect specific assignments?

This study is needed as a pandemic has not disturbed education for over 100 years [6]. This pandemic has given rise to the need to understand our Gen Z student population and how they assimilate knowledge [7]. Most of the students in our classroom started college during or after the onset of the pandemic; this study helps us understand if online material was sufficient for students or if their presence at the school impacted their performance.

Given the unprecedented disruption caused by the pandemic, understanding the relationship between in-person attendance and student performance is crucial. By examining the students' learning experiences [8] and outcomes of students who began their college experience during or after the pandemic, this study will contribute to a deeper understanding of how this shift has affected student learning outcomes and educational experiences [9]. This study explores how student engagement and academic performance have evolved in the post-pandemic era. By understanding these dynamics, we can develop effective strategies to support student success and contribute significantly to education research.

Literature review

Over the past three years, the world has undergone significant changes triggered by the onset of the pandemic. In March 2020, the world was thrust into the "new normal[1]," necessitating a swift transition to ERI in education. Despite online education being a trend for the past two decades [4], educators quickly adapted to this new mode of instruction. This transition continued, leading to the adoption of HyFlex mode, a blend of online and in-person instruction. During these transitions, educators focused on providing materials and teaching classes effectively. Traditionally, class attendance was a requirement, but this norm shifted due to the sudden transitions. Different modes of instruction emerged [10]:

Regular in-class lecture setting: This traditional format involves teaching primarily in classrooms, requiring students to be physically present[11].

Online teaching: Online instruction, existing for over a decade, became prevalent during the pandemic due to its flexibility, convenience, time management benefits, and enhanced interaction opportunities[12].

HyFlex: This new and innovative teaching method that blends hybrid and flexibility is called HyFlex. This unique teaching mode allows students to have the autonomy to opt between online or in-person instruction, providing them with more flexibility. Instructors provide all the necessary materials through the primary learning management system (LMS).[13]

There has been a shift in our perception regarding attendance and student performance in this post-pandemic era. Traditionally, attendance was seen as crucial, with studies showing its positive correlation with academic performance [14-16]. However, some research suggests that mandatory attendance may only sometimes benefit students. Studies on medical students found no correlation between academic performance [17] and the number of hours spent studying, challenging the notion of compulsory attendance[18]. Moreover, mandatory attendance has been associated with various benefits, including fostering social connections, facilitating communication, promoting interaction with instructors, and enhancing learning outcomes, specifically in synchronous modalities[19]. In conclusion, the pandemic has remodeled educational practices, leading to the implementation of diverse instructional modes. [20]

Research Methods

For this research study, we conducted a cross-sectional analysis to assess the impact of students' attendance on their performance in a STEM design course. Our objective was to observe how students' presence in the classroom affects their academic outcomes. We utilized 15-week attendance data, students' exam grades, and lab grades to investigate the relationship between attendance and performance across three semesters. Throughout this study, we employed Pearson correlation to understand the relationships between attendance and academic achievement.

Site and Participants

We collected data from 153 undergraduate STEM students enrolled at the University of Florida during the Fall 2022, Spring 2023, and Fall 2023. The course under assessment was Technical Drawing and Visualization, a STEM course focused on 2D and 3D design using AutoCAD. The classes were conducted entirely in person, with course content shared through the LMS Canvas. Examinations were also administered in person. Most students enrolled in this STEM course were civil engineering majors, primarily in their sophomore or junior years.

Measures and Data Collection

Data collection included students' performance across various assignments, including three lab assignments, midterm exams, final exams, visualization assignments (forms), computer exams, and their attendance during weekly classes. The course comprised two weekly class meetings, each lasting two hours. Attendance was recorded by the instructor at the end of each class session and documented on Canvas.

Attendance (Rollcall): This data is tracked by keeping track of the student's presence in class

Lab assignments (Lab): Students create drawing files on AutoCAD using instructions sheets. They are graded on their ability to create drawings based on accuracy and following standards.

Forms: these assignments are hand drawings, which help students in their visualization ability; they also build their spatial skills. They are taught orthographic, isometric, cross-section, and auxiliary views. These assignments test their ability to visualize and create these views.

Computer exam (Compexam): This has a time constraint of 2 hours. They are evaluated based on their ability to create drawings on AutoCAD.

Exams: This has an hour of time constraint. The student's ability to understand and explain commands and tools is tested. There are two exams: one called the midterm, which takes place in the mid-semester, and the final exam is given during the final week of the semester. This includes the midterm exam and final exam.

Final score: This is the students' final score at the semester's end. This includes all the assignments mentioned above.

Students are provided with all the data that they need on the LMS to be able to complete their assignments; their presence in the classroom might come in handy because the instructor provides help after her lectures. This may only be necessary for some students, but it can help finish the assignments and reduce technical errors.

For Question 1, we analyzed students' cumulative attendance throughout the term, along with their final grades only. For Question 2, we examined students' cumulative attendance and grades in the midterm exam, final exam, forms, and lab scores. By systematically examining these data points, we aimed to discern the impact of students' attendance on their academic performance

throughout this STEM design course, thereby contributing to the broader understanding of factors influencing student success in technical disciplines.

Data Analysis

We used SPSS v29.0 and Excel to analyze the data we collected. For Question 1, we conducted a Pearson correlation [21] analysis to determine if there was a relationship between students' attendance and their performance, using final grades as a measure of performance. Specifically, we looked at final attendance data collected from the beginning of the semester until week 15. The only two pieces of data we used for question 1 were the relationship between attendance and students' final grades. We also used graphical representations to visually depict the relationship between the two variables. For Question 2, we employed Pearson correlation analysis to investigate the relationship between students' attendance and their performance in labs, forms, computer exams, midterm, and final exams – using these as measures of performance. We also used graphical representations to show trends and how student performance changed over time. Through these analytical methods, we aimed to provide insights into the correlation between students' attendance and performance in a STEM design course. We believe our work contributes to a better understanding of the factors influencing student success in technical disciplines.

Results

1. Does in-person attendance have an impact on student performance?

Table 1 Pearson coefficients demonstrate the correlation between the students' final scores and their attendance. Our analysis revealed a Pearson correlation of 0.543, indicating a moderate positive linear relationship between attendance and the final scores. This moderate positive relationship shows a positive correlation between these two variables and an increase in one variable results in the rise of the other. Moreover, a value of 0.543 is significant in this case.

The scatter plot demonstrates that most students with higher attendance also received higher assignment grades. This attendance trend remained consistent throughout three semesters. When outliers are disregarded, the trendline highlights a strong correlation between attendance and students' performance through their final score, as shown in Figure 1.

Table 1: Pearson correlation final Attendance with Final grades

N= 153		Attendance	FinalScore
Attendance	Pearson Correlation	1	.543**
FinalScore	Pearson Correlation	.543**	1

**. Correlation is significant at the 0.01 level (1-tailed).

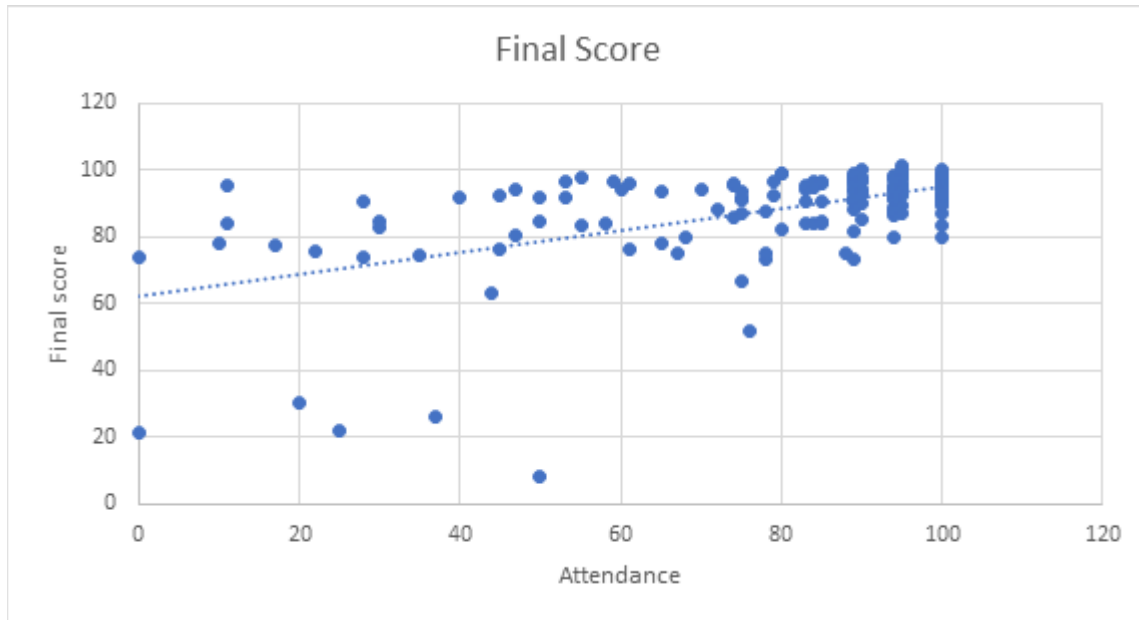


Figure 1: Scatter plot final Attendance with Final score

2. Does students' presence in the classroom significantly impact specific assignments?

The Pearson coefficients in Table 2 show the correlation between students' assignment grades and final attendance. Firstly, let's examine the relationship between midterm exams and attendance. Our analysis found a Pearson correlation of 0.387, which indicates a relatively weak positive linear relationship. This means there is a positive correlation between these two variables, but it's not strong. In this case, a value of 0.387 may not be considered significant. Next, we will analyze the relationship between attendance and various other assignments such as labs, forms, computer exams, and final exams. The Pearson coefficient ranged between 0.437-0.468, which indicates a moderate positive linear relationship between attendance and students' final scores. This means there is a positive correlation between these two variables, and an increase in one variable causes an increase in the other. In this case, a value in this range may be considered significant.

The scatter plot illustrates that most students with higher attendance also received higher assignment grades. This attendance trend remained consistent across three semesters. The trendline highlights a strong correlation between attendance and performance in labs, forms, and exams, as depicted in Figure 2-4 when outliers are disregarded.

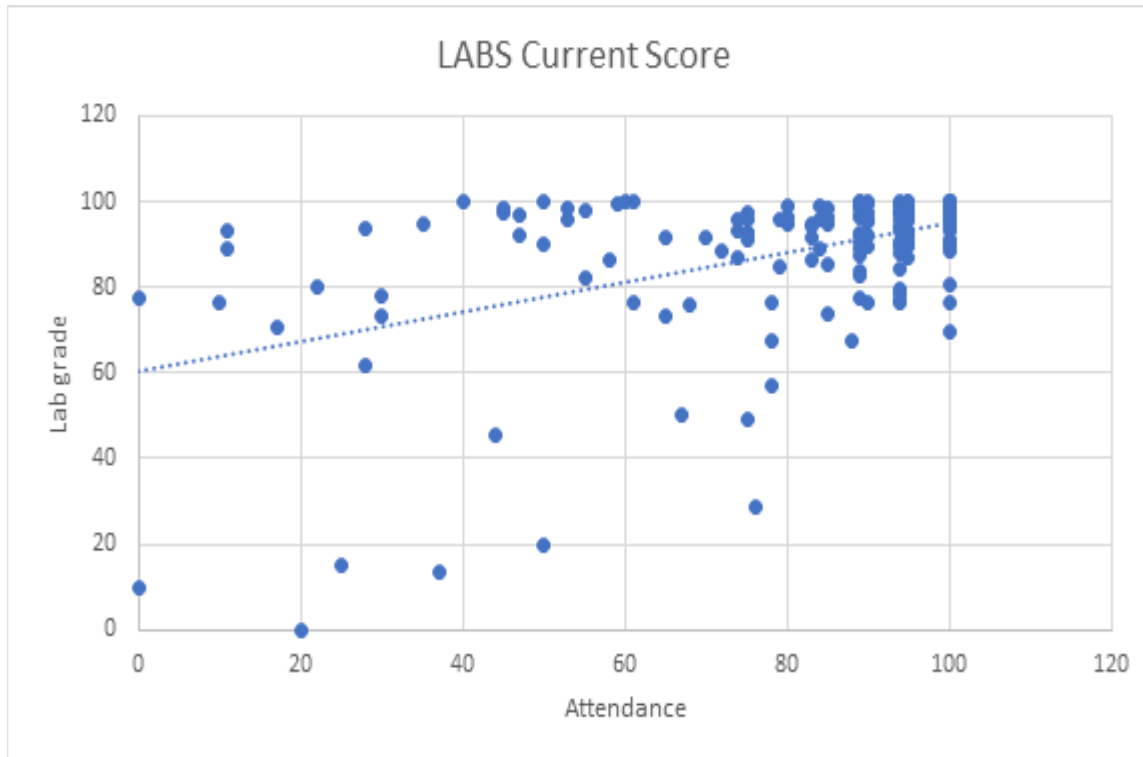


Figure 2: Scatter plot final attendance with Lab assignments

Table 2: Pearson correlation final attendance with assignments

N= 153	Attendance	Midterm	FinalExam	Lab	Form	CompExam
Attendance	1	.387**	.468**	.462**	.450**	.437**
Midterm	.387**	1	.432**	.482**	.593**	.475**
FinalExam	.468**	.432**	1	.669**	.607**	.749**
Lab	.462**	.482**	.669**	1	.505**	.712**
Form	.450**	.593**	.607**	.505**	1	.540**
CompExam	.437**	.475**	.749**	.712**	.540**	1

**. Correlation is significant at the 0.01 level (1-tailed).

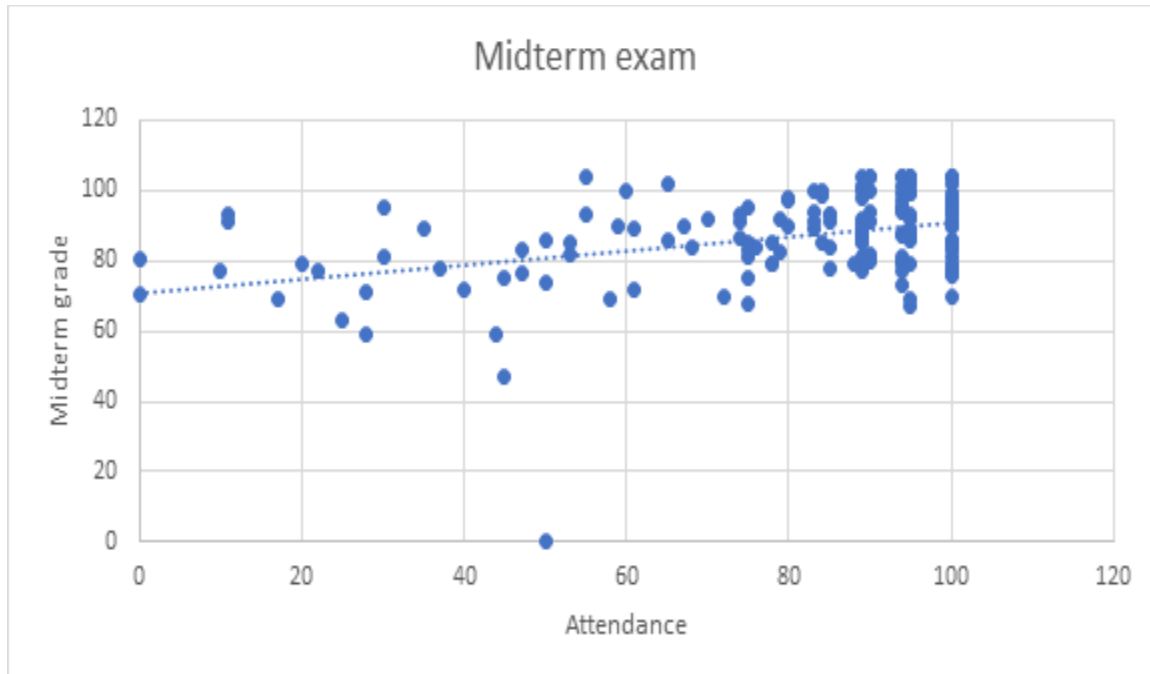


Figure 3: Scatter plot final attendance with Midterm exams

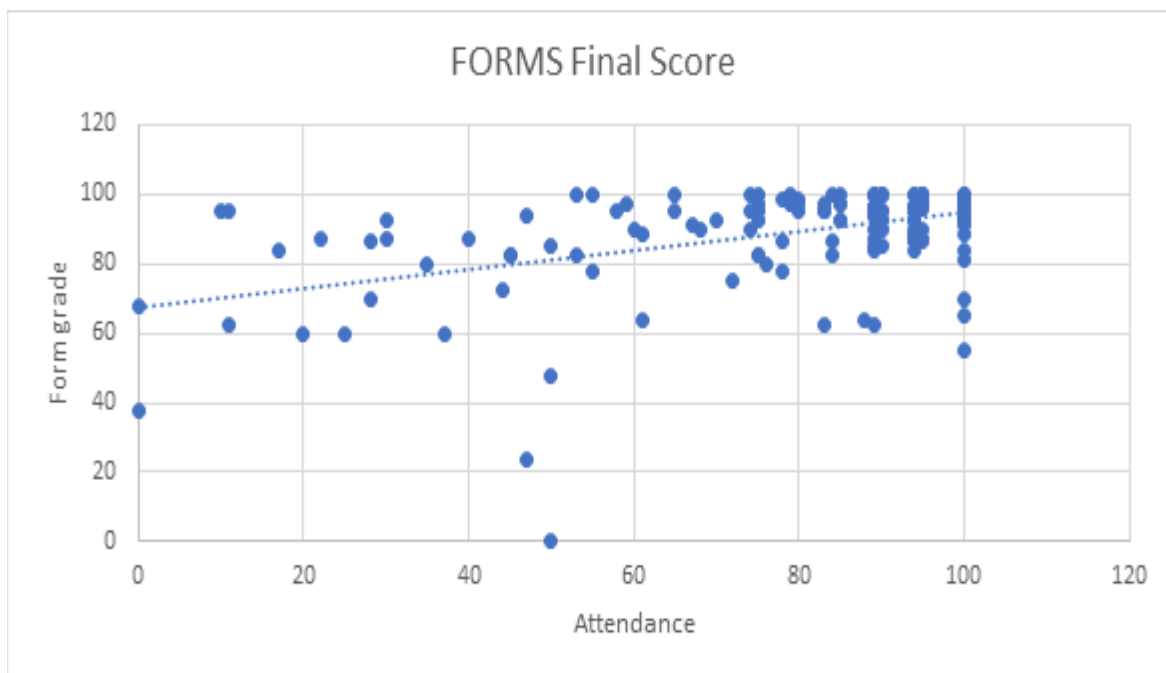


Figure 4: Scatter plot final attendance with Forms (Visualization assignments)

Discussion and Conclusions

Our primary objective in conducting this study was to investigate the significance of students' attendance on their performance, addressing the following questions:

1. Does in-person attendance influence student performance?

The study results indicate a moderate positive correlation between students' final scores and attendance, with a Pearson coefficient of 0.543. This means students who attend more classes tend to achieve higher scores, hence establishing a statistically significant relationship between students' attendance and their final scores. Figure 1, which displays a scatter plot, illustrates this positive trend. Across three semesters, higher attendance correlates with higher final scores consistently. The trend line emphasizes a strong correlation between students' attendance and their final scores, especially when outliers are excluded, highlighting the importance of consistent attendance for academic success. However, it's important to note that the study's findings could benefit from expansion beyond a single year. This could be achieved through multiple studies across different courses, which would provide deeper insights. The limited data scope from three semesters restricts our understanding of the significant impact on student grades.

The paper's findings suggest that presence in class impacts the student's grades, just as mentioned in our literature [16]. But the impact has been medium to medium-high, making it not a significant revelation. There are benefits outside student performance that are the domino effect of attendance, as JJ Shieh[19] mentioned, which have not been investigated in this study.

2. Does students' presence in the classroom significantly affect specific assignments?

For this part of the study, we explored the relationship between students' attendance and their various assignment grades (labs, final exams, midterm exams, computer exams, and forms). The analysis revealed a positive correlation between midterm exams and attendance. Strong correlations were found between attendance and other assignments such as labs, forms, and computer exam, suggesting attendance influences students' performance. Furthermore, we found a statistically significant correlation between different assignments. This correlation highlights the interconnectedness between different assignments. Students who performed well in labs, forms, and commuter exams also succeeded in the final exam. These findings underscore the importance of consistent Attendance and its impact on students' overall success throughout multiple semesters.

Limitations and Future Prospects

Future research can address its limitations by including data from multiple courses, expanding the sample size to cover more STEM classes, and investigating the influence of different teachers on student performance and attendance. Furthermore, the research can group students into those who engaged with the online materials and those who were completely disengaged. The instructor plans to incorporate online and HyFlex options in future course offerings and expand this study by monitoring attendance and its impact on performance. This study provides a basis for exploring the relationship between attendance and student outcomes and will pave the way for further research into its underlying mechanisms.

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To assist the writing process, the help of AIs was used; for example, we used Grammarly AI to correct grammar, check sentence formations, and improve writing.

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