An empirical study of student performance during the COVID-19 pandemic

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ABSTRACT

This paper aims to establish if any of the following characteristics are associated with a difference in student performance during the COVID-19 pandemic: online lecture attendance, study time and performance; gender, class standing *(freshman (1st year), sophomore (2nd year), junior (3rd year)and senior (4th year))* and having one's own room. A Learning Management System was used to measure students' study times and performance on the assessments. A survey instrument was used to obtain information about their gender, class standing, whether they had their own room and their perceptions of online education. The study found a positive correlation between study times and performance, except for test 1 and its study time, and a positive relationship between academic performance and having their own room. There was also a difference noted between class standing and performance, however, there was no difference based on gender in the performance of the students.

Keywords: *COVID-19 pandemic; online learning; study time; performance; gender; class standing*

INTRODUCTION

Many factors affect students' learning, including attendance, study time, environment conditions, educator characteristic of family and health issues. Performance of students is assessed in various ways throughout the term. Three decades ago, before the advent of technology, attendance was very important for traditional education. Students accessed information from their textbooks and from in-person lectures. As time passed, technology has impacted our daily lives and has provided different alternatives to learning. Distance education, web-based education, online education, blended (hybrid) education, synchronous and asynchronous education, are alternative models for the traditional mode of education. Distance education, which began as correspondence courses in the nineteenth century and grew into educational television during the twentieth century, evolved into learning on the Web by the mid-1990s (Perry & Pilati 2011). In the 1960s distance education, where the teacher and learner were at different locations, used the postal service to send the print-based materials to the learner. New advances in technology during the 1980s, saw academic courses delivered to learners via TV (Keegan 1996).

Distance education was revolutionized by the major inventions of the personal computer and the Internet, then the new alternative model, Web based education took effect. In Web based education, teaching content, such as the course outline, course schedule, recorded videos and other resources, are uploaded to websites and learners interact with the teaching media through the Internet without communicating face-to face with the instructor. With technological advancements, Learning Management Systems (LMS) that is a software that helps to create, manage, organize, and deliver online training materials to the audience, including Blackboard, Moodle, Brightspace, Canvas, and Sakai, have played an important part in learning at educational institutions. Posting announcements, lecture notes, recorded lecture materials, review questions, assessments, recording students' marks, testing and assignment submission, and communicating with the students in the online environment are some important features of LMSs.

Students access many online sources other than textbooks to learn. The main functions of LMS are to manage and register users, provide resources and formative activities, access, check, control and monitor the learning process, facilitate the conduct of evaluations and manage communication

services such as forums (Bri *et al.,* 2009). Online education is the modern form of distance education or the extension of web-based education. In online education, teaching and learning processes are conducted in a virtual environment, using online platforms and tools. There are three types of online education, asynchronous, synchronous and hybrid. According to the University of Waterloo website, asynchronous education means that the instructor and the students in the course all engage with the course content at different times and locations and activities such as watching pre-recorded lectures, reading assigned materials, and participating are all in discussion boards. Synchronized education means that the instructor and the students in the course engage with the course content and each other at the same time, but from different locations and activities such as live-streaming lectures and participating in video-conference discussions. Hybrid education is a mixture of asynchronous and synchronous education.

In the middle of March 2020, the COVID-19 pandemic lockdown spread across the world and the transition from class attendance to online learning was difficult. During this transition, many universities switched to online teaching to minimize interruption to learning (Ruzgar & Chua 2021; Elmer *et al.,* 2020). The main problems were the lack of technological infrastructure for universities, and instructors' lack of knowledge of technology after being forced to deliver courses online in a short time. Technological advancements helped them to solve these problems. Students were able to access recorded lectures, course materials and assignments through the LMS and attended the live lecture via Zoom or Google Meeting as well as communicate with each other though the LMS, WhatsApp groups, Facebook, and other online communication programs. Lecture attendance was reduced due to the following reasons: online resources for the courses, working part-time or full time to cover school tuitions and life expenses, or instructor characteristics, even though attendance is very important for learning and performance.

Scholars are very interested in the relationship between attendance and performance, study time and performance or gender differences in performance. This study was undertaken to explore the association between performance and the following factors: study time, attending online live lectures, study time and assessment marks, gender, class standing and having one's own room during the COVID-19 pandemic.

The rest of the paper is organized as follows. Section 2 discusses the relevant literature; Section 3 describes the research objectives and methodology. Section 4 presents the research findings and Section 5 discusses the findings. The conclusion, implications and highlights for future research are discussed in the final section.

REVIEW OF THE LITERATURE

Many university educators promote class attendance, as it is a commonly held belief that academic success is related to class attendance (Nieuwoudt 2020). Students' performance during their education may have significant implications for their career and beyond. Their performance depends on several factors, including lecture attendance, study time, living environment, students' social and economic conditions. Lecture attendance is a useful predictor of subsequent course performance. According to previous studies, the association between performance and attendance, study time, gender differences and class standing attracted the interest of many scholars across various disciplines to develop attendance policies that maximize instructional efficiency (Pérez-López & Ibarrondo-Dávila 2020; Lu & Cutumisu 2022). The thesis that class attendance would influence the performance has been explored in several studies (Ontong *et al.,* 2020; Irwin *et al.,* 2018; Dey 2018; Kwak *et al.,* 2019; Kassarning *et al.,* 2017; Almutawa & Suwaidan 2019; Karnik *et al.*, 2020; Bekkering *et al.,* 2020). While several scholars reported a positive relationship between attendance and performance (Irwin *et al.,* 2018; Dey 2018; Kwak *et al.,* 2019; Kassarning *et al.,* 2017; Almutawa & Suwaidan 2019; Rendleman 2017; Tetteh 2018; Milushka *et al.,* 2019; Shah &

Barkas 2018), some of them did not find such a relationship. (Baillie *et al.,* 2022; Chapin 2018; Lu & Cutumisu 2022; Choi-Lundberg *et al.,* 2020; Rawlani *et al.,* 2018).

The influence of study time on performance is another topic of interest. One scholar found that class attendance, mid-semester exams and study time could explain more than 34 percent of variance and had a significant positive influence on the learning outcome (Tetteh 2018). Similarly, it was found that total hours spent studying before an exam has a large, positive, and significant effect on course grades (Dey 2018). In another study, a significant relationship was again found between academic success and the number of hours students participated in and interacted with the online learning system (Nieuwoudt 2020).

In many of the empirical studies, gender differences are explored. One study found a positive correlation between gender and performance: gender gaps in participation and final course grades were positively correlated, but this could have resulted from a higher proportion of female students attending classes and earning a higher grade (Bailey *et al.,* 2020). However, in another study, it was found that gender is not a significant determinant of students' performance in an Accounting course (Almutawa & Suwaidan 2019).

Class attendance was very important for learning in traditional education. Textbooks and face to face classes were the only information source for students. The rapid growth of technological advancements since the 1980s creates both opportunities and challenges for education. D evelopments in communication and Internet technologies have had a major impact on education. College faculty, for example, can create Web pages for their course using an LMS such as Blackboard, WebCT, or Sakai by uploading the course related materials, including the PowerPoint slides for their lectures. The students could then download these PowerPoint files, print them, and write their own notes on the printed material. These features improved their learning. Faculty-student communication also becomes easier with the course Web site. Besides distance and online education, traditional face-to-face in class education retained its importance until the COVID-19 pandemic.

The coronavirus (COVID-19) pandemic is an unprecedented emergency that has dramatically affected all global industries, including education (Stone *et al.,* 2020; Ayittey *et al.,* 2020). With the spread of COVID-19 globally in March 2020, a global lockdown was imposed and educational institutions across all levels (from elementary to tertiary) closed in 188 countries across the globe, impacting over 91% of the world's student population (Ruzgar & Chua 2021; Stone *et al.,* 2020; Ayittey *et al.,* 2020; UNESCO 2020). Around 1.7 billion learners were affected due to COVID-19 by the temporary suspension of their educational activities (Ruzgar & Chua, 2021; Noor *et al.,* 2020; Chua & Ruzgar 2020) and then continued with online education. To deliver live lectures, universities could make a new contract or extend their contracts with the different virtual teleconferencing (VTC) platforms, such as Zoom, Google Meet, and Microsoft Teams (Ruzgar & Chua 2021). Although Generation Z were born in the technology age, they had many adaptation problems and without any preparation they were placed into a fully online learning environment with the sudden changes due to COVID-19. During the pandemic, many scholars were interested in the impact of online education on students' performance, in student perceptions of online education, gender differences, anxiety and mental health, among many issues. (Nieuwoudt 2020; Ontong *et al.,* 2020; Almutawa & Suwaidan 2019; Karnik *et al.,* 2020; Lu & Cutumisu 2022; Bailey *et al.,* 2020; UNESCO 2020; Chua & Ruzgar 2020; Profirovic *et al.,* 2021; Clark & Post 2021; Baillie *et al.,* 2022).

This study explores how students' performance is impacted by attendance, study time, gender and class standing for online lectures during the COVID-19 pandemic.

RESEARCH OBJECTIVES AND METHODOLOGY

Students' academic performance is the most crucial factor not only impacting their learning, but also their future career. Students' academic performance depends on a variety of factors related to lecture attendance, study times, and having their own room. There are many research studies in the literature dealing with the performance of students, however, with the sudden transition from traditional learning to online learning due to the COVID-19 pandemic, student performance has attracted interest from researchers in related fields. This study aims to investigate the contributing factors that affect the academic performance of students during the COVID-19 pandemic with the following research questions:

- Is there any association between the lecture attendance and the students' performance?
- Is there any association between the study times and the students' performance?
- Are there any gender differences in the students' performance?
- Are there any class standing differences in the students' performance?
- Are there any differences of students having their own room on the students' performance?

In this study, the data were collected in two ways: first an online survey was used to collect the students' demographic information and their perceptions of online learning using a 5-point Likert scale ranging from strongly disagree to strongly agree. The LMS was then used to obtain students' marks, study times and class attendance. Data from 2456 students were collected from the LMS to examine a possible correlation between performance and study time, class attendance, and class standing. A second set of data from 313 students who participated in the online survey were collected to examine students' perceptions of their performance in terms of gender, class standing and having their own room. Students participated in the survey voluntarily. Their grades, class standings, study times and attendance were collected anonymously with their permission. The data were collected during the Fall and Winter semesters in 2020 and 2021, respectively, at two Canadian universities in Ontario. 313 students out of 2456 students participated the survey of which 167 (53.4%) were males and 146 (46.6%) females. 167 (53.4%) students were first-year students, 93 (29.7%) second-year students, 36 (11.5%) third-year students and 17 (5.4%) fourth-year students. Among the participants, 259 (82.7%) had their own rooms and 54 (17.3%) did not. 95 (30.4%) passed with grade A, 67 (21.4%) with grade B, 78 (24.9%) with grade C, 51 (16.3%) with grade D and 22 (7%) failed the course with a grade F.

Among the 2456 students, 1242 (61.0%) were 1st year, 545 (26.8%) 2nd year, 147 (7.2%) 3rd year and 102 (5.0%) 4th year students. Similarly, among the 2456 students, 520 (21.2%) passed with grade A, 635 (25.9%) with grade B, 655 (26.7%) with grade C, 379 (15.4%) with grade D and 267 (10.8%) failed. For simplicity, the grades A+ (90-100), A (85-89) and A- (80-84) were represented by A (80-100); B+ (77-79), B (73-76) and B- (70-72) by B (70-79); C+ (67-69), C (63-66) and C- (60-62) by C (60-69); D+ (57-59), D (53-56) and D- (50-52) by D (50-59); and failing by F (0-49). The course evaluation includes two midterm tests, a final exam and 10 weekly assignments. SPSS and Excel were used to analyze the data.

FINDINGS AND DISCUSSION

In this section, findings about the impact on performance of total study times, attendance, gender differences, class standing and having their own room are discussed.

Relationship Between Performance and Total Study Time

The study times for each assessment were computed by taking the sum of time spent on online lectures, doing weekly assignments and doing extra practice on the online assignment platform. For example, "To_ST_T1_Ass" represents total study time for Test 1, considering all assessments prior to Test 1, including total time spent in attending four online lectures, doing three weekly assignments (Assignments 1-3), and doing extra exercises on the online platform.

For midterm Test 1 and midterm Test 2, students were tested on the topics covered from week 1 to week 4, and from week 5 to week 8, respectively, but the final exam covered all topics from week 1 to week 12. The descriptive statistics for the assessments, namely means and standard deviations, are shown in Table 1 below. The data shows the mean mark of all the assessments, and it is noted that the study time from Test 1 to Test 2 has decreased. Since the final exam was comprehensive, total study time was computed in minutes from the beginning of the term to the end.

Table 1: *Descriptive statistics of the assessments*

Descriptive Statistics	Mean	Std. Deviation
Test1	68.13	18.38
Test2	61.52	21.10
Final_Exam	59.84	18.23
Overall Assignment_Av	55.08	34.30
Overall Average	66.63	16.35
*To_ST_T1_Ass (1-3) (min)	977.42	628.96
**To_ST_T2_Ass (4-7) (min)	857.48	614.20
***To_ST_Final_Ass (1-10)(Min)	2416.9	1660.53

*To_ST_T1_Ass (1-3): Total study time for Test 1 and Assignments 1-3;
**To_ST_T2_Ass (4-7): Total study time for Test 2 and Assignments 4-7;
***To_ST_Final_Ass (1-10): Total study time for Final and Assignments1-10.

The correlation between the study times in minutes and the mean value of the student performance are shown in Table 2. As can be seen from the correlation matrix in Table 2, there are moderate correlations at 0.01 level between the overall average and the mean of Test 1, Test 2 and the final exam marks, but there is a weak correlation between the overall average and average marks of all assignments. The mean of Test 2 marks and total study time for Test 2 and the mean of the final exam marks and total study time for the final exam are both positively correlated, however there is no association between the mean of Test 1 marks and the total study time for Test 1 at the significance level of 0.01.

Table 2: Correlation among the overall average, marks and total study time for the assessments

| Parametric Correlations (Pearson)	Test1	Test2	Final _Exam	Assignment _Av	Overall Average	To_ST_T1 Ass (1-3)	To_ST_T2 Ass (4-7)	To_ST_Final Ass (1-10)
Test1	1							
Test2	.393**	1						
Final_Exam	.451**	.558**	1					
Assignment_Av	.180**	.239**	.185**	1				
Overall Average	.622**	.683**	.775**	.330**	1			
To_ST_T1_Ass (1-3)	-.064**	0.041	-0.022	-.058*	.225**	1		
To_ST_T2_Ass (4-7)	0.018	.104**	.067**	.110**	.306**	.808**	1	
To_ST_Final_Ass (1-10)	0.016	.105**	.070**	.067**	.308**	.905**	.932**	1

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

Online Lecture Attendance Behavior

Lecture attendance has long been regarded as a vital component of a quality education, but with the accessibility of online materials and the ever increasing opportunities to study online, the viability and value of face-to-face classes is being challenged (James & Seary 2019). According to one study, there is a direct correlation between lecture attendance and student performance (Massingham & Herrington 2006).

In this study, lecture attendance was computed as a percentage of the total time the students stayed in class, divided by 150 minutes which corresponds to three 50 minute lectures in a week. The mean, median and 95% confidence interval boundaries of the mean lecture attendance are illustrated in Figure 1a while attending and absent percentages of students are shown in Figure 1b.


Figure 1a*: Class attendance mean, median and 95% confidence interval

Figure 1b*: Class attendance percentages
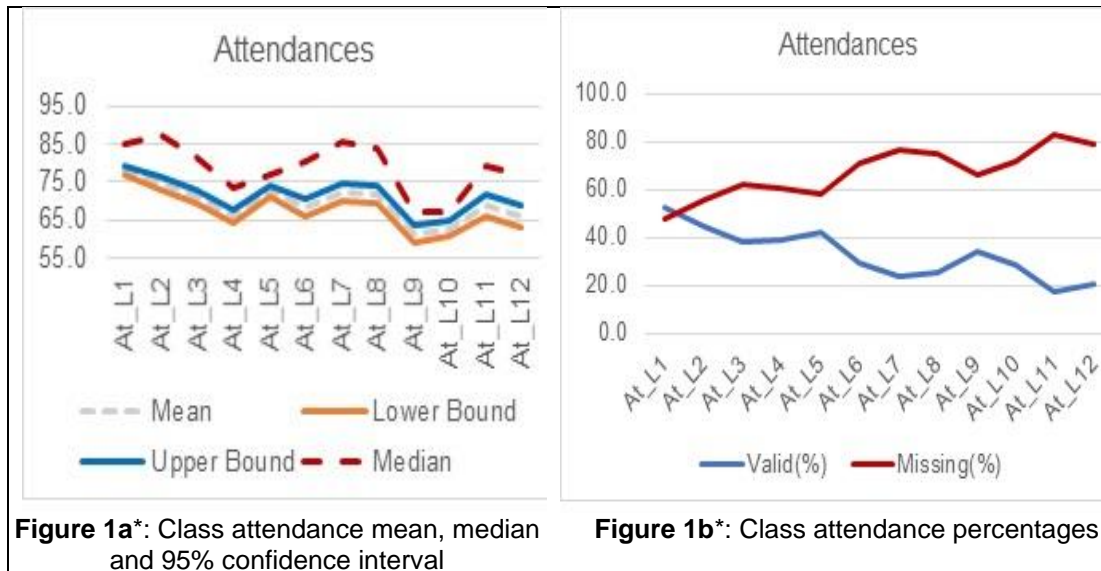
*At_Li (i=1, 2, ... 12) represents attendance to the 12th lecture

According to the data in Figure 1a, the attendance rate decreased during the 12-week period of classes except for the test week . From week 1 to week 4, the attendance mean reduced approximately 12.1%, but increased 7.2% points in week 5, in which the first midterm test was held, then decreased again 4.8% in week 6. After the first midterm test marks were released at the end of week 6, attendance increased 4.3% in week 7. In weeks 7 and 8, the attendance rate increased 4.3% due to Test 2 held in week 8. There was a dramatic decrease (10.1%) in week 9, then a 1.9% and 6.7% increase in week 10 and week 11, respectively. Finally, there was a 3.1% decrease in week 12. According to the 2456 students' attendance shown in Figure 1b, attendance decreased from week 1 to week 3, then increased from week 3 to week 5. After decreasing from week 5 to week 7, it increased until week 9, decreasing again from week 9 to week 11 then increasing in week 12. This shows that students do not attend class on a regular basis, rather they prefer to attend class in the assessment week to find out about the tests. There are several reasons for this absenteeism, including availability of lecture recordings which were posted on the course website and accessible any time for watching, extra practice questions on the online assignment platforms, online tutoring videos, and online office hours. It seems that a synchronous course has become an asynchronous course. In addition, most of the students have part-time jobs during their studies to pay for their living expenses, tuition and to gain work experience before graduating. Course content and difficulty, concentration during the online lectures and characteristics of the instructor are the other reasons for absenteeism (Almutawa & Suwaidan 2019.
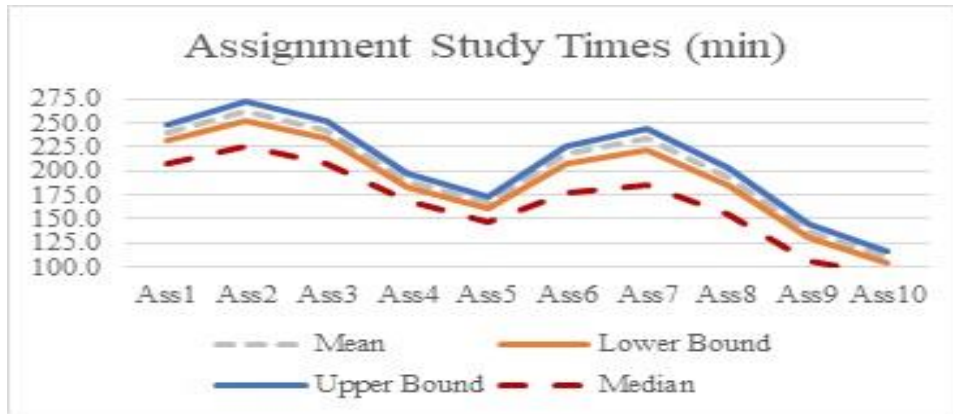
Assignment Marks and Study Time Changes

The ten (10) assignments in the course are worth 20% each and are submitted weekly with the first assignment due in week 2. Each assignment's due date is set on the first day of lecture until the start of the next lecture covering the previous lecture topics. There is a 25% penalty imposed on late work submitted after the due date. Figure 2 shows the graph of means, median and 95% confidence intervals of assignment marks. It seems that the means of assignment marks, like the attendance rate, decreased to the end of the term, which shows that students' performance decreases parallel to their attendance rate. This finding is supported by the literature, and non-attendance at lectures and tutorials appears to be a growing trend (James & Seary 2019; Massingham & Herrington 2006). According to the data in Figure 2, the means of the assignment marks decreased from Assignment 1 to Assignment 4, increased for Assignment 5, then decreased again for Assignment 6. After increasing for Assignment 7, the means of assignment marks gradually decreased to Assignment 10. Like the attendance rate, students spent more time on the assignments during the weeks of midterm tests, so the means of assignment marks also increased during those weeks. However, towards the end of the term the means of the assignment marks decreased which could be attributed to the increase in the quantity of materials to study, and the responsibilities in their other courses.
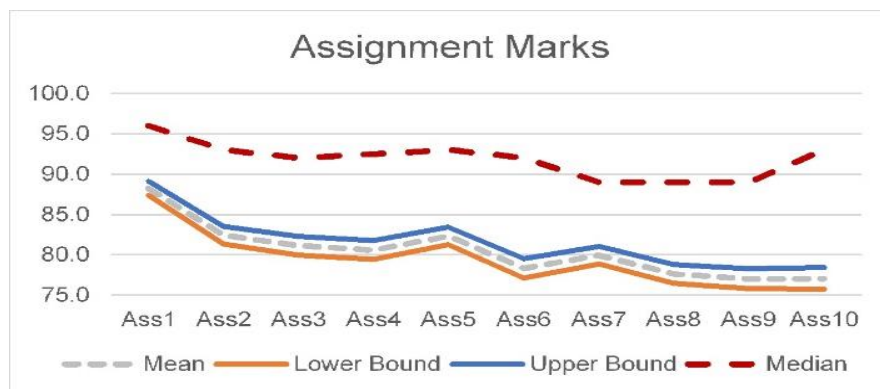
Figure 2: Assignment marks

The means of assignment study times measured in minutes are shown in Figure 3 below. The graphs are similar to those for attendance and assignment means. While students spent an average of 239.5 minutes and 262.1 minutes for Assignments1 and 2, respectively, the study time was reduced to 167.5 minutes for Assignment 5, then increased to 233.2 minutes for Assignment 7. The lowest value, 111.1 min., occurred for Assignment 10. This is not a surprising finding after noting their attendance behavior and assignment marks patterns.

Figure 3: Assignment Study Times in minutes.

Therefore, when the correlations between assignment marks and assignment study times were examined at level of 0.01, it was found that there was a significant correlation between assignment marks and assignment study times as shown in Table 3 below.

Table 3: Correlation between the assignment marks and assignment study times

	Pearson	Sig. (2-tailed)
Ass1-TS_Ass1	.175**	0.00
Ass2-TS_Ass2	.247**	0.00
Ass3-TS_Ass3	.217**	0.00
Ass4-TS_Ass4	.308**	0.00
Ass5-TS_Ass5	.321**	0.00
Ass6-TS_Ass6	.306**	0.00
Ass7-TS_Ass7	.310**	0.00
Ass8-TS_Ass8	.295**	0.00
Ass9-TS_Ass9	.351**	0.00
Ass10-TS_Ass10	.259**	0.00

*Assi-TS_Assi: Assignment i by Total study time of Assignment i.
** Correlation is significant at the 0.01 level (2-tailed).

The correlations between the assessments, Test 1, Test 2, Final exam and overall average, and the corresponding study times were significant at the 0.01 level of significance for the wider group of 2456 students as shown in Table 4. These findings are a valuable contribution to the literature (Tetteh 2018; Rawlani *et al.,* 2018).

Table 4: *Correlation between assessments and their total study times for 2456 students*

|	Correlations	
	Pearson	Sig. (2-tailed)
Average-To_ST_T1_Ass (1-3)	.225*	0.00
Average-To_ST_T2_Ass (4-7)	.306*	0.00
Average-To_ST_Fin_Ass (1-10)	.308*	0.00
Average-Total_extra_study_time	.118*	0.01
Average-Total_Time_min	.272*	0.00

* Correlation is significant at the 0.01 level (2-tailed).

Performance

In this section students' performance is compared with gender, class standing and having one's own room. The demographic information on gender, class standing and having one's own room were collected from a survey of 313 students and were used for this comparison study. The letter grades A, B, C, D and F were used to measure students' performance in the course.

Gender and Performance

The performance distribution of 167 (53.4%) male and 146 (46.6%) female students is shown in Figure 4. The graph was drawn based on the frequencies, then percentages related to gender were added into bars. As shown in Figure 4, there is no big gender difference in performance. Both genders have approximately the same performance on grades A, D and F. Only small differences are seen on grades B and C. While female students received more B grades, male students received more C grades. It can be concluded that, for online courses during the COVID-19 pandemic, there is no gender difference on student performance.
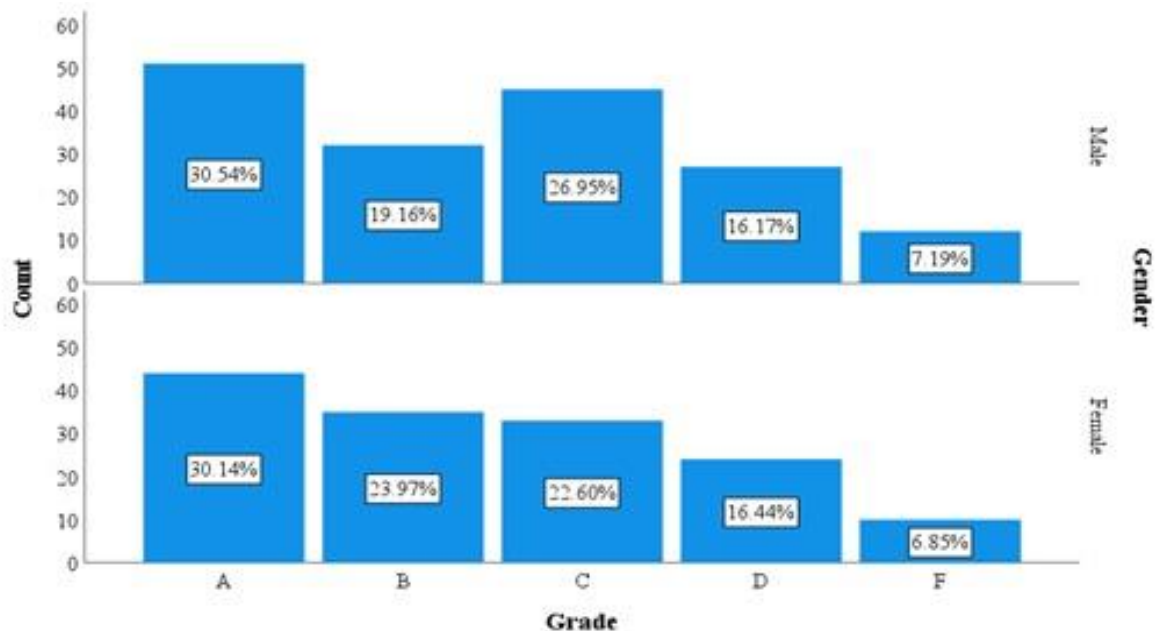
Figure 4: Student performance by gender

Class Standing and Performance

The grade distributions of first-year, second-year and third-year students are quite similar. However, the grade distribution of the fourth-year students is slightly different from the other three grade distributions. For the grade A category, the fourth-year students have the highest percentage, 47.09%, followed by third-year students, 30.56%, first-year students, 29.94%, and second-year, students 27.96% (see Figure 5). In comparison, the third-year students performed better in the grade B and C categories. Among the class standing, the lowest percentage of passing grades for first-year students is the B grade, for fourth-year students it is the grade C. The grade distributions in percentages of the first-year students and second-year students are quite similar. The fourth-year students have the highest failing rate; however, the third-year students have the lowest failing rate. The higher failure rate for the fourth-year students could be attributed to their three years of in class learning before the COVID-19 pandemic and they were required to switch to online learning during the pandemic. In addition to the mental problems, financial problems, sudden transition from traditional to online courses, the fourth-year students were in the graduating year, which increased their anxiety level to learn effectively.
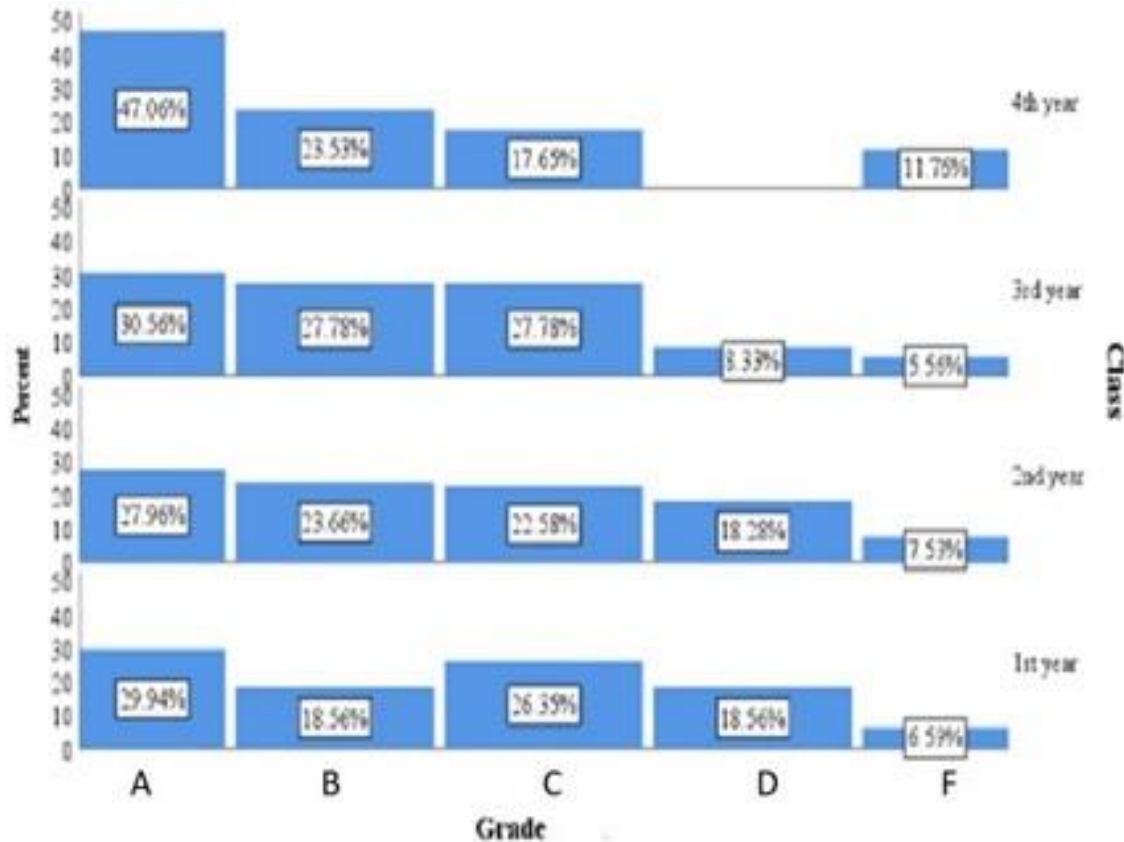
Figure 5: Student performance by class standing

The new generation of students who are technology savvy adapted to the online system very quickly and adjusted their learning abilities for online courses during the pandemic. Since the first-year students and the second-year students experienced the transition from in person to online

education during their high school education, they easily adapted to online education at the university during the pandemic.

One of the possible reasons for the high passing and low failing rates is due to cheating. Although different methods of testing design were implemented for online assessments to prevent students from cheating, the findings from another forthcoming study suggest a relatively higher rate of cheating on the online assessments. After experiencing two years of the COVID-19 pandemic, students' preferences for online courses have increased significantly with 73%, expressing preference over the traditional courses. Surprisingly, the result was in the reverse direction before the pandemic. Although students took some online courses before the pandemic, in the transition term only half of them expressed preference for online courses.

Own Room and Performance

It was thought that having their own room increases student's performance for online courses, because while attending the lectures or taking an online test, a student must stay in a quiet room. Since the tests are monitored by the proctoring software - "Respondus LockDown Browser and Monitor" - they must write the test using a reliable computer with a webcam and microphone in a quiet room to reduce the cheating rate and ensure a fair assessment. If there is a noise or somebody else in the room, the system creates a flag for investigation. The results of the performance of students by having their own room are shown in Figure 6 below. There is no big performance difference for the grade A category, but the failure rate of 16.67% for students who do not have their own room, is three times more than the failure rate of 5.02%, for students who have their own room. For grade B and C categories, the percentage of students having their own room is higher than the percentage of students not having own room for each of these grade categories. This distribution pattern is the opposite for the grade D category. This shows that the performance of students is positively impacted by having their own room.
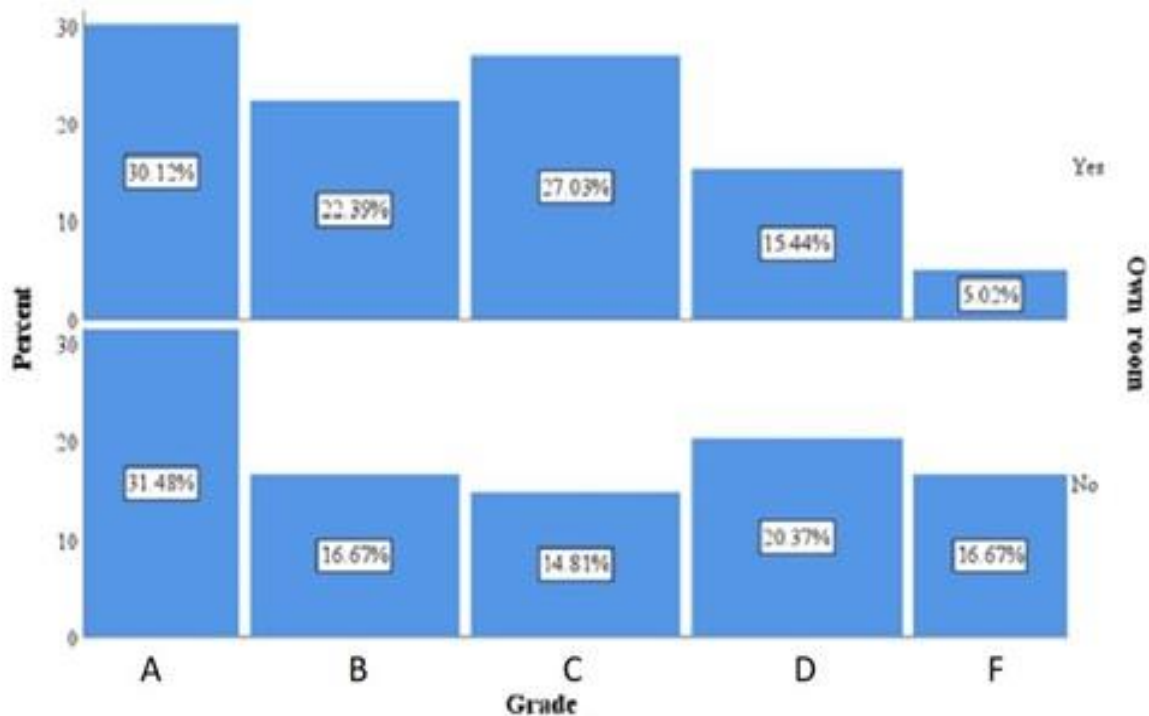

Figure 6: Student performance by having own room

CONCLUSION AND FURTHER STUDIES

In this study, student performance was compared with lecture attendance, study time, gender differences, and having their own room during the COVID-19 pandemic. Due to the pandemic, after the shutdown started in March 2020, all lectures were delivered online using Zoom meetings to reduce the gap between in-person learning and online learning. Fully online learning may pose a challenge when delivering technical math-related courses because online instruction may be less dynamic than traditional delivery, even though current technology and techniques have improved the nature and effectiveness of online delivery (Lin 2022). Although the students in this study struggled in the transition term (in-person learning to fully online learning), it changed over time. According to a study about students' perceptions toward online learning in the transition term and during the pandemic, while students preferred online learning before the transition term, their preference shifted to traditional learning in the transition term due to having all lectures online (Ruzgar & Chua 2021). However, students' preferences changed slightly during the COVID-19 pandemic, approximately 75% of them preferred online learning to traditional learning (Chua & Ruzgar 2020). The sudden lockdown caused many problems, economically, mentally, and socially. The pandemic forced some students to work either part-time or full time to support themselves or their families, therefore leading to a shift of preference from in-class courses to online courses for time flexibility to hold a job while studying. Furthermore, most online courses have recorded lectures that are available for students to watch later without having to attend lectures.

In this study, the LMS was used to collect study times, attendance and students' performance on different assessments throughout the term, as well as a survey instrument was used to obtain the students' demographic information. The mean marks of the assessments, Test 1, Test 2, final exam and weekly assignments decreased gradually through the end of the term. Parallel to the assessment means mark, total study times, which were the sum of time spent in live lecture on Zoom, test topics related to four assignments and solving review questions on the website, also decreased from Test 1 to Test 2 even though the Test 2 topics were harder than the Test 1 topics. Since the final exam was cumulative, using LMS recordings, the total study time for the final exam was computed as taking the sum of time spent in all online lectures, doing assignments and extra online review questions. When the Pearson correlation was applied for the study times and performance, the finding showed that the students' performance had a significant positive relationship with students' study times at 0.01 level of significance, except the total study time for Test 1 and Test 1 marks. Since the data were collected from the first year required courses and most students were in the transition term from high school to university, they studied Test 1 from different online sources, other than the assigned course materials. The time spent on other online sources was not included to compute the total study times in this study. This could explain the finding of no association between the Test 1 marks and total study time for Test 1. The impact of extra time spent on different sources is one of the limitations for this study. Given that students were taking all their courses online, they might have difficulty managing their time to study all courses, so they would do only mandatory requirements, like assignments, not spending time on extra online sources as they did for Test 1. The findings contribute to the literature on the association between study time and performance (Nieuwoudt 2020; Tetteh 2018).

Most of the research has found that lecture attendance was a very important factor for positive learning outcomes (Nieuwoudt 2020; Ontong *et al.,* 2020; Shah *et al.,* 2018). In this study, online lecture attendance, which was measured in minutes then was converted to percentages, declined throughout the term. Students attended the first lecture, then their attendance started to decrease until the first test, the attendance rate then increased in the week of Test 1, then decreased again until Test 2. After increasing in the week of Test 2, which was in week 8, then

the attendance was at the minimum level within the term starting in week 9. For week 10 and week 11, the attendance rate increased gradually until the last week, and in week 12, it decreased again. Although online education provides different opportunities to students to access course materials, recorded lectures, review questions on their own time, and student interaction on the LMS, it is believed that it not easy to learn mathematics and statistics on their own. One scholar found that students who attend less than half of the classes did not perform well academically compared to the students who were attending more classes (Nieuwoudt 2020). On the other hand, another scholar found that offering online Zoom lecture meetings remarkably enhanced students' satisfaction with the course and the instructor and reduced the gap in effective instruction between traditional and online settings (Lin 2022). The reasons for absenteeism varied and attracted the interest of many scholars. Illness was unquestionably the most cited extenuation (Irwin *et al.,* 2018), more so during the pandemic. One scholar found that absenteeism reflects low levels of motivation that might have a link with extensive socialization among students, part-time jobs, poor physical or mental condition, and excessive sleepiness. Another scholar suggested that the behavior of students is motivated by factors such as personal attitudes, lifestyle choices, work values, and personality traits (Khan *et al.,* 2019; Epstein *et al.*, 2007). The characteristics of the instructor, how the instructor encourages student attendance, and how the instructor makes the class engaging, also contributed to the reasons for absenteeism. The time of the class and how these variables affect absenteeism was researched in another study (Marbouti *et al.,* 2018). They found that students were more likely to miss early morning classes. In a course based on active learning, this lower level of attendance has a negative relationship with student performance, including the ones who attend the class regularly, suggesting active learning may amplify the negative effects of missing classes (Marbouti *et al.,* 2018).

The 10 weekly assignments with the first assignment due in the second week of the term had a total weight of 20%, and significantly impacted the performance of the students. They were created to increase the level of learning outcomes. Along with the live lectures, they provided various examples and practice questions to help the students retain the knowledge of the topics better. Knowing this, students should spend more time doing the assignments, but the findings showed that assignment marks dramatically decreased from the beginning to the end of the term like the student attendance behavior. It is not surprising that the study times for assignments performed parallel to the assignment marks in a decreasing trend. This shows that the study time and performance on assignments have a strong association to each other at the significance level of 0.01. The findings showed the same significant association of study times on student performance. This finding is a contribution to the literature (Nieuwoudt 2020; Tetteh 2018).

Gender difference on performance is another commonly studied topic. One scholar found that the overall academic performance of Accounting students was not independent of their gender, but in another study the researchers found that students' attendance rate in Accounting courses was independent of their gender (Almutawa & Suwaidan 2019). In another study, it was found that gender gaps in participation and final course grades were positively correlated, but this could be attributed to the fact that female students are more likely to participate more and earn higher grades in classes with many females in attendance (Bailey *et al.,* 2020). Findings revealed no gender difference on the performance of students. Only a small difference was seen in the grade B and C categories. While more female students received a B grade, more male students received a C grade. Percentages of the other grades, A, D and F, for both male and female students were distributed very close to each other. When the students' performance was compared to their class standing, it was seen that first, second and third year students had approximately the same percentage distribution on grades, but it was the opposite for the fourth-year students. Approximately 47% of the fourth-year students passed with grade "A" while the percentage of other level of students ranged from 27% to 30%. A similar distribution pattern was seen for grade F. The 11.76% of fourth

year students who failed the course compared to the other level of students who failed, ranges from 5.5% to 7.5%. Since these were the first-year courses, most of the fourth-year students took the course before and either dropped or failed. Since the fourth-year students were repeating the course, they were familiar with the course materials and they wanted to graduate and start to work, therefore they were more motivated to perform. This explains the high percentage of grade A earned by them. It is interesting that the passing rate with A, B or C categories on the online courses is much higher than the traditional courses. The main reason is one word, "cheating". Although the "Respondus LockDown Browser", offers the option for shuffling the questions and answers, the features letting them see one question at a time and not allowing them to go back to the previous question, were used to design the online tests and exams, yet they still find a way to cheat. It seems that students have adapted to the online system as the pandemic restrictions come to an end, because their preference for online courses since the COVID-19 pandemic has shifted to traditional courses during the transition term and then shifted back to online courses during the pandemic (Ruzgar & Chua 2021; Chua & Ruzgar 2020).

The variable, having their own room, is an important factor for students' performance in online courses, but there was no study using this variable found in the literature. Students need a silent room to attend the live lectures and to write the tests or exam online. The findings revealed that having their own room had a positive impact on performance. The failure rate of students not having their own room is approximately three times that of students who had their own room. For grade B and C category, the percentage of students having their own room was greater than the students not having their own room. For grade A category, there is no difference. Students not having their own room passed the course with lower grades. Thus, it can be concluded that having their own room has a positive impact on student performance for online courses.

In summary, the findings of this study revealed that high level of attendance, study time and having own room have a significant positive impact on student performance, and there was no significant difference on gender performance. To maximize student learning, instructors should encourage the students to attend the lectures, motivate them to participate in the class discussions, and make the lectures more engaging or lively using technological tools.

There are some limitations of this study. The data analysis in this study did not include study time spent on either home study or using different online sources other than the LMS and the assignment study website. Another limitation is the availability of lecture recording that could affect students' attendance was not considered in this study. In this study, 313 out of 2456 students participated in the survey, which corresponds to 12.7%, the remaining, 87.3%, may cause non-response bias resulting from sensitive questions asked in the survey. For further studies, concerning preference change of students, pre and post COVID-19 pandemic should be considered, with the cross-cultural perspective to make comparison between different country contexts and culture. Moreover, searching online exams and cheating, and how anxiety and mental issues of students have impacted performance during the COVID-19 pandemic and post COVID-19 pandemic, inspires further studies.

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