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Impact of COVID-19 on Faculty Teaching and Student Learning

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Impact of COVID-19 on Faculty Teaching and Student Learning

Abstract

The year 2020 started with the corona virus outbreak which had life-changing consequences for nearly all aspects of human life, including businesses, academics, office work, and personal interactions. Almost all activities that are deemed non-essential have become remote, relying heavily on online interfaces, and this virtual lifestyle has now been referred to as a "New Normal" for people everywhere. Academic institutions have been particularly impacted, with the pandemic disrupting the way colleges and universities hold classes and interact with students. Most institutions have cancelled in-person classes and switched to online-only instructions, and this sudden change mid-semester from the spring of 2020 has posed difficult challenges both for the teaching faculty and students. In this paper, we discuss the impact of the pandemic on teaching and learning for students who were registered for onsite classes but had to switch to online offerings. How did they respond to this change, did they perform better or worse? How were the faculty who taught these courses impacted? In what ways did instructors have to adjust their teaching styles? This research compares student performance and success rates across various courses in response to online teaching and discusses shifts in teaching methods required of faculty during this transition.

Introduction:

The sudden outbreak of the COVID-19 pandemic in early 2020 shook the world and disrupted nearly all types of human activities worldwide. Responses to the outbreak included community-wide lockdowns and the shutdown of offices, businesses, and educational institutions among other events. When these lockdowns began, many institutions of higher education in the United States were either in the middle of their spring semester or had already started spring break. Lockdowns delayed the opening of those that were on break, while other institutions decided to switch to online modes of teaching and learning. However, online teaching and learning in its entirety is dependent on technological smart devices and internet connection. There is no denying that there have already been high rates of growth and adoption of technology in education even before COVID-19, and there has been a significant surge in the usage of advanced educational tools and online learning software such as language apps, virtual tutoring, video conferencing tools, etc. [1] since the start of the pandemic. However, despite this advancement and growth, much of the world was not prepared for such a sudden change to this level of heavy internet dependence for once in-person activities, and many instructors and students had no prior experience in online teaching and learning before the start of the pandemic. Instructors and students who do not have access to reliable high-speed internet connections or the appropriate equipment and tools have found this online mode of teaching and learning to be particularly challenging [2]. In addition, because instructors who have not previously taught online courses do not have the prerequisite experience or skills necessary to conduct successful online instructions, which differ from skills needed to conduct onsite classes. Therefore, such professors are struggling to effectively connect with and teach their students. On the other hand, students who are not accustomed to online classes had to struggle to manage the change in expectations and loss of in-person assistance as well as onsite class experience. This paper discusses the challenges of teaching and learning as a result of COVID-19 pandemic, evaluate the effect of the COVID-19 pandemic on the teaching and learning of computer science courses at two institutions of higher education in the United States. Authors also identify and discuss the academic challenges faced by teachers and students in a setting for

which they were not prepared. The results reported and compared here are based mainly upon authors' own experience at School #1 and program data at School #2. The collected data did not distinguish between the faculty/student genders and/or ages. Selected courses at School #1 consist of the few mainstream courses in a typical IT and CS streams. The data at School #2 is from courses offered in a graduate program. It was our effort to collect data from in-sequence classes before and after pandemic. We tried to collect the data for same set of students as they proceed through their study. We also included both graduate and undergraduate courses. The collected data consists of 10-20 tracked students in CS/IT course sequence at School #1 and 16 students in graduate program at School #2. No statistical analysis was conducted on the collected data at this stage.

It is also worth mentioning that the paper does not attempt to compare use of various Learning Management Systems (LMS) used by different academic institutions to facilitate delivery of lectures, exams, assignments, and other activities. However, we compare the issues and challenges of synchronous teaching via Blackboard Collaborate and Microsoft Teams. This paper is an initial attempt to understand impact on student and faculty teaching due to COVID-19. Future studies may include detailed faculty responses to understand the impact on faculty teaching due to pandemic.

VARIOUS APPROACHES:

The COVID-19 pandemic started affecting the lives of millions of people since the beginning of 2020, and it is still an emerging situation as well as continuing to spread worldwide [3]. It has critically impacted all areas of life, including the education system, and presents unique challenges for students, instructors, and academic institutions. In response, a quick shift from onsite modalities to online modalities at academic institutions during and after spring 2020 have impacted teaching activities on a large scale. The study in [4] revealed that onsite classes providing higher opportunity for interpersonal contact has positive impact on students' educational performance. The same paper also reports that physical activity performed under any conditions has a great influence on stress management. However, the COVID-19 Pandemic situation forced academic institutions to adapt and consider new educational approaches to traditional online methods of teaching.

Students had to adjust to the unforeseen circumstances and take online classes that were originally planned for face-to-face format. In a typical online class at the beginning of the semester, faculty tries to set expectations and orient students to the online learning environment [5]. This would typically be achieved by sending an e-mail to students, including a copy of course outline, course goals, and policies at the beginning of the class. In addition, there could be situations when access to digital devices and internet may not be achieved by all students [6]. The study in [4] reports that although over 75% percent of students had accessibility and participated in these online classes but there was a reduction in the students' motivation in actively and constantly participating in the online classes which negatively impacted their academic performance. Agrawal & Kaushik [7] showed in their study that student participants in a survey believed that the online sessions helped them to change their routine and material presentation was easier to access. Authors in [8] indicated that student had good level of motivation to attend to the online topics, that was ultimately helpful in reducing the COVID Pandemic stress among students. Research reported in [9] focused on how

the faculty effectively adopted their teaching of important learning outcomes from face-to-face to remote teaching. Authors state that the survey conducted among their faculty shared negative views of switching from onsite to online teaching, although some shared effective approaches used to address challenges, they faced due to the switch.

IMPACT ON STUDENT LEARNING

Following are the details of the data collected from school #1 and school #2 to analyze impact of Covid-19 on student learning.

School #1: This data is from a state university that offers both undergraduate and graduate programs. Note that there are several failing grades and withdrawals due to pandemic (shown as "x" in Table #2 and shown as 10 in Figure #1) during pandemic semesters. In addition, there are several withdrawals and NAs (not attended due to unreported reasons) in Table #2 and shown as 5 and 7 in Figure #1. Students attending the courses out of sequence (pre-pandemic completion) are shown as blanks in both, Figure #1, and Table #2, and these are not included in our study. It is obvious from Figure #1 and Table #2 that Fall 20 was really a disaster in terms of students staying away or failing due to Covid-19. To get a better understanding of students' grade patterns in nine major courses, a similar data for another group of ten students was collected from pre-pandemic (Fall 18 or before to Summer 19). The plotted results in Figure #2 clearly shows that the grade pattern is unaffected in pre-pandemic times.

Table 1: List of required courses for school #1.

Courses	N1	D1	W1	N2	P1/P2
Description	NW Fund.	Database Fund.	Web Fund.	Interm. NW	Prog. 1/2
Courses	IT3-1	IT3-2	W2	P2	
Description	Junior IT1	Junior IT2	Interm. Web	Prog 2	

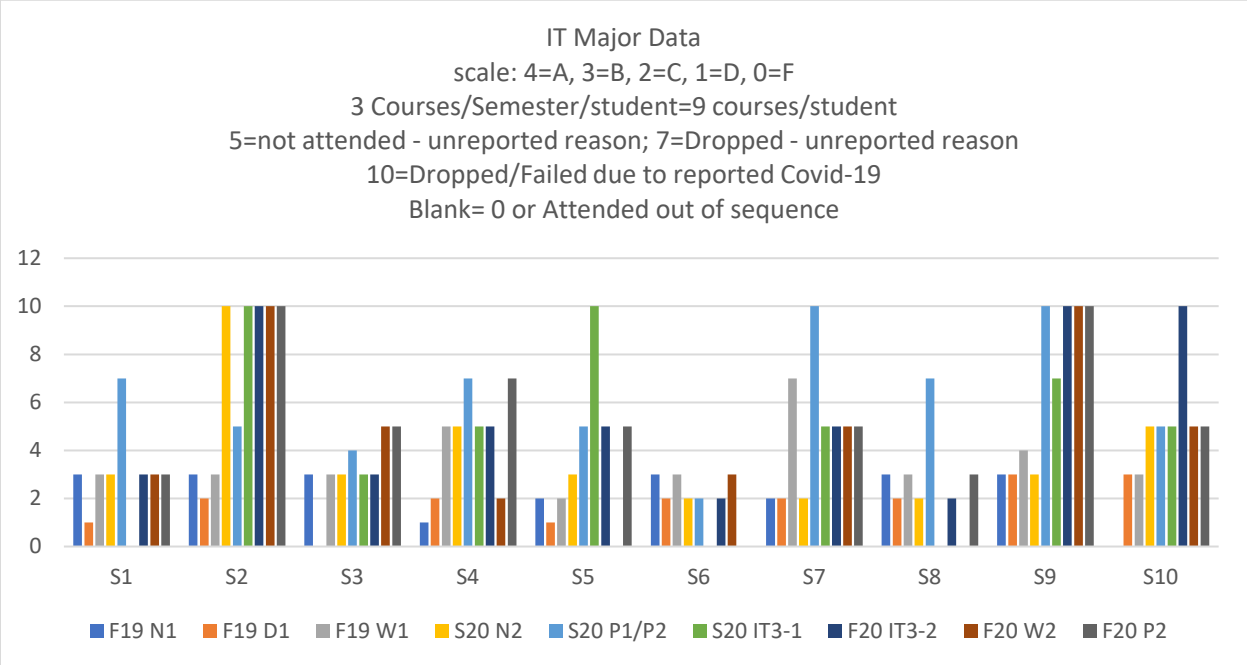

Figure 1: Student performance for school #1.

School #2: The data used for this case study is from a graduate program, that is offered three times a year and each offering is called a String. This program is offered at Department of Engineering and Computing at a private non-profit university. In some cases, students are registered and start the program in one string and due to any reason move to a different string thus taking courses according to their own convenience, rather than following recommended sequence in the original string. In Table #3 we have a list of courses from this graduate program at School #2. The program offers each course in one course one month format, which means student will take one course in one term (month) and move on to the next course the following term (month). Table #3 shows onsite string that started in February 2020 but had to be moved to online format in April -2020 due to the pandemic situation. This string had 16 students, although some of the students skipped a course here and there but the data still provides some statistics to get some idea about the impact of pandemic on student performance. Each column in Table #3 shows the months when courses are offered, the highlighted months are when the classes were moved to online format. C #1 to C #10 are the courses offered during these months, exact course names are not used. Figure #3 shows the variation in grades in classes taken before and after pandemic.

Table 2: Student data for school #1.

F19=Fall 19 or before	Student	F19	F19	F19	S20	S20	S20	F20	F20	F20
		N1	D1	W1	N2	P1/P2	IT3-1	IT3-2	W2	P2
A=4	S1	3	1	3	3	W		3	3	3
B=3	S2	3	2	3	X	NA	X	X	X	X
C=2	S3	3		3	3	4	3	3	0	
D=1	S4	1	2	0	0	W	NA	NA	2	W
F=0	S5	2	1	2	3	NA	X	NA	0	NA
	S6	3	2	3	2	2		2	3	
	S7	2	2	W	2	X	NA	0	0	0
	S8	3	2	3	2	W		2		3
	S9	3	3	4	3	X	W	X	X	X
	S10	0	3	3	NA	NA	NA	X	NA	NA

F19=Fall 19 or before	F20=Fall 20 or Summer 20
A=4	X=Dropped due to reported Covid-19 or not attended due to ureported reason
B=3	W=Dropped
C=2	NA=Not attended due to unreported reason
D=1	Blank=Attended out of sequence
F=0	

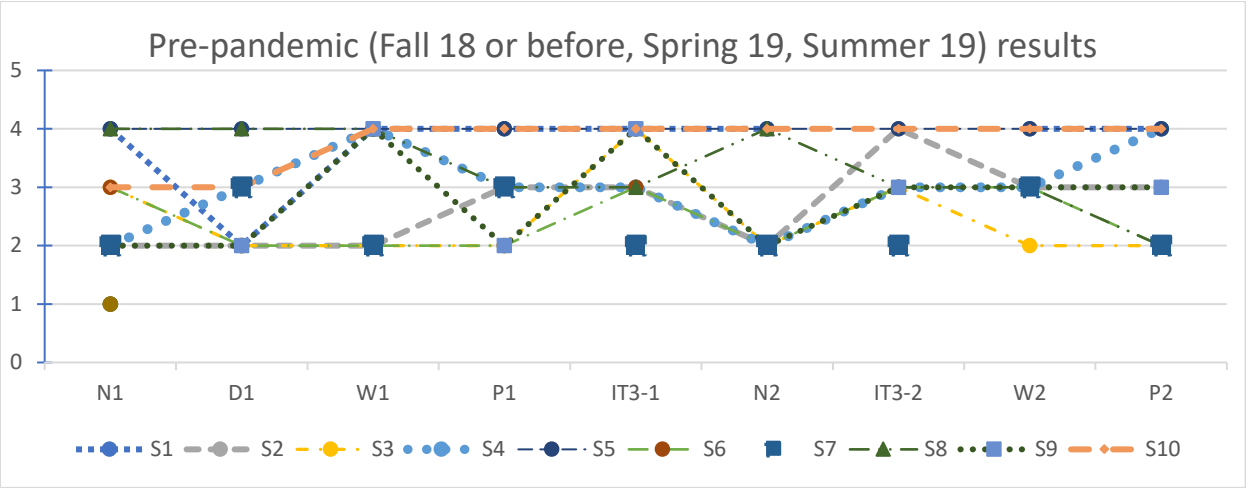

Figure 2: Student pre-pandemic grade pattern for school #1.

Table #4 shows onsite string for the same program at school #2 that started in September 2019 but had to be moved to online format in April -2020 due to the pandemic situation. Unfortunately, this string did not have a big number of students but still provides statistics that is still good enough to get some idea about the impact of pandemic on student performance. Figure #4 shows graphically the impact of the pandemic situation in terms of variation in grades in classes taken before and after pandemic.

Table #3: Courses in a Graduate Program (One Course One Month Format) for school #2

Stud	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
	C#1	C#2	C#3	C#4	C#5	C#6	C#7	C#8	C#9	C#10
1	3.3	3.7	3.3	4	4	4	4.0	3.7	3.7	4.0
2	3	3.7	3.3	3.3	4	4	3.7	3.0	3.7	4.0
3	3	3.7	2	2.7	3	4	3.7	2.7	2.7	3.3
4	2.3	3.7	3	2	2.7	3.7	3.3	3.3	3.3	2.7
5	2.3	3.3	0.7	1.3	3.3	2	1.7	1.3	0.0	
6	3	3.7	3.3	4	4	4	3.7	3.3	3.7	3.7
7	4	3.3	3	3.7	3.7	4	4.0	3.7	3.7	3.3
8	3.3	3.7	3.7	3.3	3.7	4	3.7	2.3	4.0	4.0
9	2.3	3.7	3	2.7	3.7	4	3.0	2.7	3.7	4.0
10	3	3.7	3.3	3.3	3.7	4	3.7	3.7	3.7	4.0
11	2.3	3.7	3.7	3	3.7	3.7	2.7	3.0	3.0	3.3
12	2.3	3.3	3.3	3.7	4	4	4.0	3.7	3	3.7
13	2.3	3.7	3	2.7		3.7	3.3	1.7	3.7	
14	2.3	3.7	3.3	3	3.7	4	2.3	3.0	3.3	3.3
15	2.7	3.7	3.3	3	3.7	4	3.7	3.3	3.7	4
16	4	3.7	3.7	3.3	3.7	4	**3.7**	3.3	4	3.3

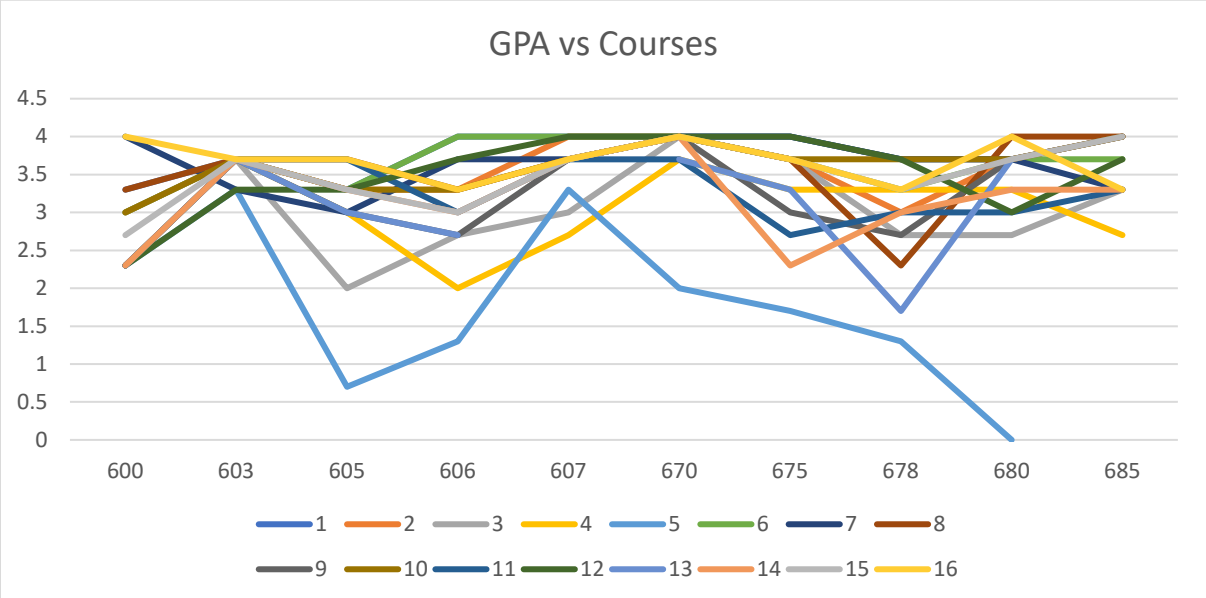

Figure 3: Variation in grades before and after pandemic for school #2.

In summary it is safe to say that the data for the program from school #2 does not show any significant impact on student performance due to shifting classes from onsite to online format other than normal variation in grades that can be seen in normal circumstances. Although a closer look at the data from Graph #3 and #4 shows that student performance was initially impacted due to shift in classes to online format, but students quickly recovered and got used to the online format.

Table #4: Courses in a Graduate Program (One Course One Month Format) for school #2

Stud	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep
	C#1	C#2	C#3	C#4	C#5	C#6	C#7	C#8	C#90	C#10	C#11	C#12	C#13
1	1.3	3.7	2.7	3.3	3	2.7	3.7	3.7	3.3	3.0	4.0	4.0	4.0
2	2	3.7	3	3	3	3.7	3.0	3.3	3.0	3.7	4.0	4.0	4.0
3	3	3.7	3.3	3.7	3.7	3.7	3.7	4.0	3.7	4.0	4.0	4.0	4.0
4		3.7	2.7	3.3	4	4	2.7	3.7	3.7	3.7	4.0	4.0	4.0

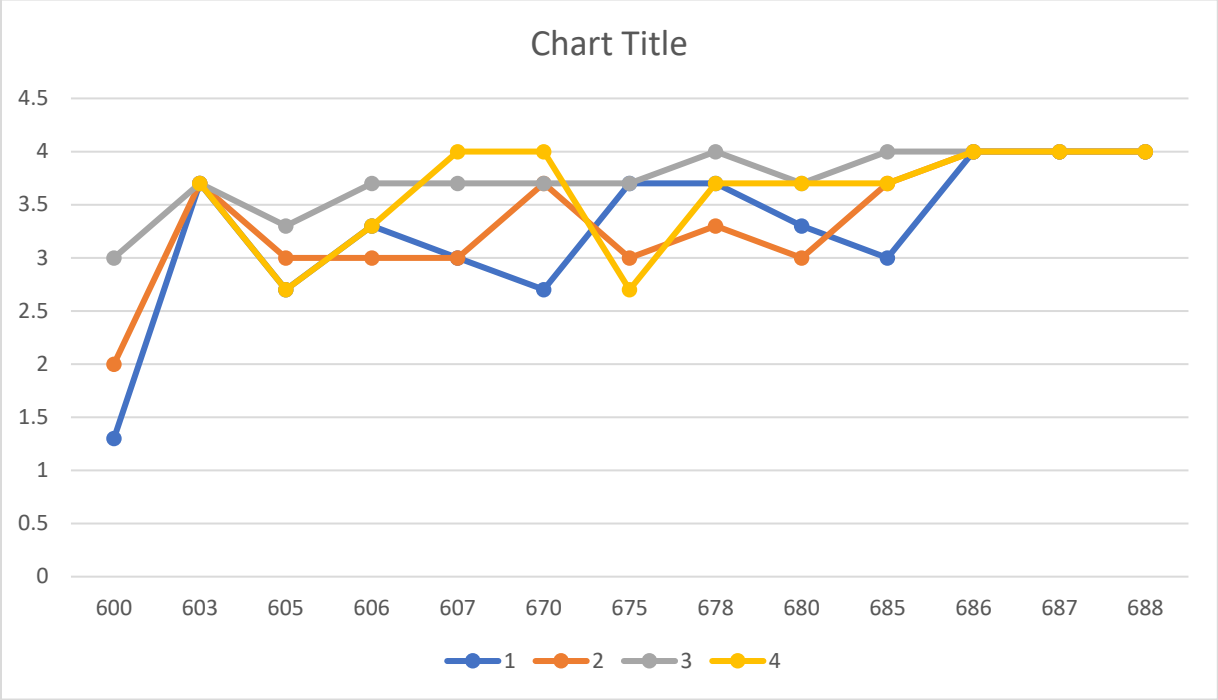

Figure 4: Variation in grades before and after pandemic for school #2.

In school #1 further data were collected for the CS majors from the CS/IT department of school #1. We tracked the performance of a selected group of computer science (CS) major before and after the pandemic. Figure #5 shows a 2-D plot of course grade for 7 students (S1-S7) from Spring 19 to Fall 20. We selected five courses (C1-C5) in computer science that all CS majors are required to take. We looked at the performance of the cohort of those seven students that started with course C1 in S19 then proceeded to take C2 in F19 before the pandemic. While these students were in course C3 in Spring 2020 the pandemic started and then those that succeeded in C3 went on to take C4 and C5 in Fall 2020 during the pandemic. Table #5 lists the courses with a brief description.

Table 5: List of CS Courses for Performance Tracking from school #1.

Courses	C1	C2	C3	C4	C5
Description	Intro Seq CS1	Intro Seq CS2	Org and Arch	Network	OS

Figure #5 shows a plot of student performance data plotted over pre-pandemic and during the pandemic semesters. The chart shows that there was negative impact on student performance due to covid-19. The data are given in Table #6.

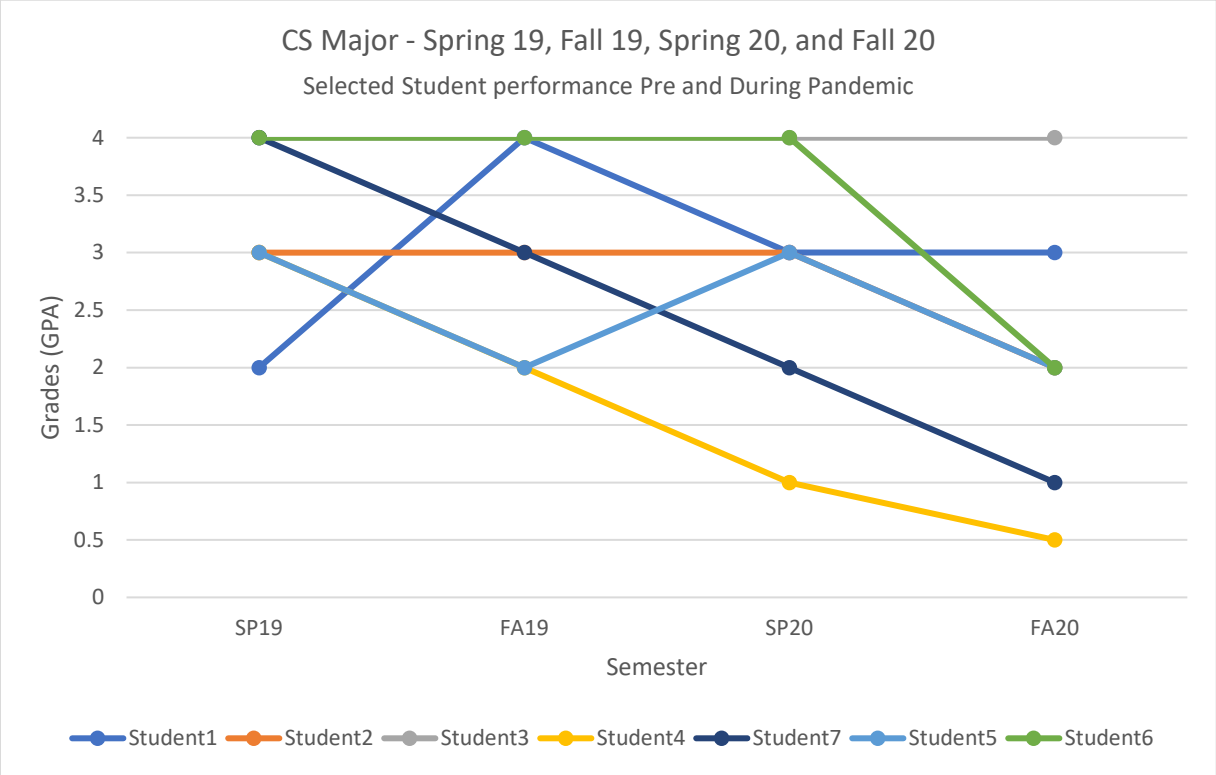

Figure 5: Plot of Selected Student Performance Pre- and During Pandemic from school #1

Table 6: Performance Data for Selected Students from school #1

	Student	S19	F19	S20	F20	F20	F20
		C1/S19	C2/F19	C3/S20	C4/F20	C5/F20	Avg: C4, C5/F20
A=4	S1	2	4	3	3	3	3
B=3	S2	3	3	3	2	2	2
C=2	S3	4	4	4	4	4	4
D=1	S4	3	2	1	1	**0**	0.5
F=0	S5	3	2	3	2	2	2
W=0	S6	4	4	4	**0**	4	2
	S7	4	3	2	**0**	2	1
				0 = Covid-19 dropped			

Two students out of all the students we tracked here had dropped the course due to Covid-19. The chart in Figure #5 indicates that Student3 maintained the same level of performance before and during the pandemic, whereas Student2, Student4, Student5, Student6, and Student7 had a drop in performance during the pandemic. Student1 had a slight drop from the semester prior to the pandemic but the performance of this student remained steady during the pandemic. It can be said that some students are well adapted to the new online format while others may find it difficult. However, it can be concluded from the chart that most students had seen some impact in their performance due to the new mode of course delivery which is due to the pandemic.

IMPACT ON FACULTY

The current situation has compelled both teachers and students to adapt quickly to the new reality of online education. Instructors have used variations of pedagogical techniques that they generally use in their traditional onsite classes. On the other hand, students who have traditionally taken courses in person and were forced to switch to online learning have faced their own unique challenges. In some cases, instructors who have had no prior online teaching experience were initially reluctant to teach their courses in an online format. This is true because faculty generally teaching classes in face-to-face classes, due to pandemic situation, had to teach courses in online format. These instructors are not accustomed to a 100% remote online teaching and learning environment, which for some institutions required long hours of synchronous online teaching and office hours. This has resulted in sedentary lifestyles and negatively impacted both the mental and physical health of instructors. A key challenge for educators in these classes is to keep students engaged and to ensure a productive learning experience. It is obvious that instructors need to develop some sort of strategies for delivering high quality education to students who expected a face-to-face environment and now are taking classes in an online format. While teaching online classes the faculty needs to have a well-organized course, be very dynamic and make very effective use of LMS (Learning Management System) to motivate students and use active learning techniques for keeping entire class engaged. Since students were expecting onsite classes, it is understandable that students may experience some level of anxiety in online courses, after classes are moved from conventional face-to-face environment to an online format. Anxiety can also be attributed to the type of faculty and teaching style thus can be a very significant influence on the relation between student learning effectiveness and learning environment. Although, such influence may not be obvious for students who normally take classes online than for those who take the classes in the face-to-face class.

Academic institutions used various online teaching tools for classes that were switched to online format due to pandemic. The focus was to replace the face-to-face sessions with synchronous online sessions. During the process of writing this paper authors had informal discussions with the faculty that were impacted by this shift in class offering pattern. These discussions were helpful in determining what worked and did not work for them. It is to be noted that no formal survey was conducted to collect information that is presented here.

School #1: Brightspace (Desire 2 Learn or D2L) is the online Learning Management System used at this school. Just like any other LMS, D2L adopts a timely course management that includes discussion boards, assignments, quizzes, lectures. However, this system does not include a useful

synchronous tool to allow video collaboration/interaction between student and faculty. School #1 adopted Microsoft Teams for their online class session because the school is already licensed to use Microsoft Office 365. However, this switch from face-to-face sessions was not easy due to lack of training to faculty about Team's usage. Conducting online video meetings was not difficult in Teams but there were challenges due to lack of understanding on faculty and students' part to integrate Teams with other Office products such as Calendar and Outlook. It was challenging to structure the Teams meetings for various classes and ensure that all students registered in classes could easily transition to those meetings. The situation got further complicated due to school required multi factor authentication (MFA) to sign on to school resources. Specially, it was annoying when the connection was disrupted due to network issues and the users would need to reauthenticate to be able to continue in the sessions.

Once the students and faculty got used to this new online teaching/learning platform, operation became much smoother. Many conveniences brought by Teams to synchronous sessions were a welcome change by most faculty. For instance, one-click recording of lectures, use of whiteboard and instant poll/quiz are readily built in the Teams that are normally not available in face-to-face sessions. In addition, it was straight forward to integrate the recorded lectures with D2L material. One challenge faced due to transition to 100% online format was conducting online tests and quizzes. School decided to use Respondus lockdown browser with webcam to offer the exams. Many students were unprepared for this change. Some students' computer systems were older disallowing the use of such a browser for tests. Faculty had to prepare sample quizzes before opening any online quizzes testing the lockdown browsers with webcam. In addition to Teams, some faculty used other resources such as Zoom and Slack for offering class sessions. Students familiar with these tools enjoyed the transition to these platforms. However, many students did not feel comfortable switching from traditional face-to-face classrooms to any online tools.

School #2: Blackboard is the Learning Management System used at this school for teaching online courses. All the courses that are offered in this format have a master that is used to generate a copy into the course shell for a particular offering. Blackboard Collaborate Ultra is used during synchronous chat sessions. The current situation has compelled both teachers and students to adapt quickly to the new reality of online education. In some cases, instructors who have had no prior online teaching experience were initially reluctant to teach their courses in an online format. To address this issue, many instructors have used variations of pedagogical techniques used in their traditional onsite classes. On the other hand, students who have traditionally taken courses in person and were forced to switch to online learning have faced their own unique challenges. The faculty teaching the course conduct live chat sessions with students twice a week for at least two hours. These sessions are recorded for students to play them later for review. Since attending these live sessions is not mandatory student who miss any of these sessions can listen and watch the whole session at a convenient time of their own choosing. To make full use of the potential presented by the online environment the instructor needs to play the role that is analogous to a guide on the side. In order to achieve a better teaching and effective learning atmosphere the students also need to be advised to take a more proactive and responsible role while taking an online class.

In general, online classes are required to have a guide, a recommended learning schedule detailing weekly activities to help students organize. In this effort faculty is expected to send weekly

announcements with guidance to encourage students and tips on how to follow the recommended schedule. In addition, posted online material would need to be dated and opened sequentially allowing students to catch up. Therefore, faculty who otherwise is used to teaching onsite classes now had to adapt their teaching strategy by introducing dynamic learning activities to promote student learning due to this unforeseen shift of onsite traditional lecture to online format. These learning activities had to be aimed at enhancing students' engagement with the learning materials and the class learning activities. This situation forced faculty to design most effective teaching activities for online offerings such as threaded discussions, videos, reading assignments, instructor demonstration and lab exercises. Additional activities were also required to keep the students engaged via polling/quizzing during the sessions.

While the general challenges of adopting to online offering are handled well by the Learning Management System, transition to synchronous chat/lecture session was more challenging at school #1. Graduate students at school #2 were already familiar with required video (synchronous) chat sessions from pre-pandemic times. The Blackboard Collaborate Ultra was not entirely new to faculty and/or students. However, transition from face-to-face sessions to fully online (synchronous) lecture/chat sessions was quite challenging at school #1. Students as well as faculty had to learn and adapt to the challenges to Teams as replacement of face-to-face sessions.

SUMMARY

This paper presents a mix of both quantitative and qualitative analysis (hybrid approach) and attempts to address impact on student performance as well as teaching faculty during the COVID-19 pandemic. Student performance data was collected by comparing grades of groups of students before and during the pandemic. In groups of both undergraduate and graduate students, it is apparent from our results that student performance for several students occasionally decreased during the pandemic semesters. For students who have taken online courses before, there is not much difference in their performance before and during pandemic. Instructor performance was not addressed by the collected data, but challenges and necessary changes to teaching methods were discussed. While we ponder these questions, we have taken a first look at the impact of COVID-19 on faculty teaching and student learning, and the data we present strongly suggests that the pandemic has adversely impacted student learning. In the future, this study would benefit from additional instructor surveys to better gauge the impact that sudden online teaching has had on teaching methods, as well as comparisons of grades in specific professors' classes as they have been taught in pre-pandemic semesters versus pandemic-affected semesters.

Future research with larger sample sizes is necessary to gain a more reliable insight into the effects of the pandemic on both faculty and student performance as well as the effectiveness of different online pedagogical methods. Questions that yet to be answered that we did not address in this study: what do students and their instructors perceive as the biggest challenges to online learning during a public health crisis? What methods did instructors employ to deliver effective lessons and assignments to students, and how do they compare to one another? What is the quality of support provided by the institution, and how can that be measured? Are there other metrics beyond student retention rates and GPA that might be considered?

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