

Teaching in a COVID-19 Disrupted Semester

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1. Abstract

Covid – 19 has radically changed how group activities are carried out across the world especially in countries with higher incidence of the disease, like the US. An activity of concern to the educators is face-to-face teaching in classroom, in-lab work, in-person office hours, in-class exams and group-based project activities. The Covid-19 epidemic required most educators to move all these activities online.

Given that the flipped and online classes are a common practice in this era of internet technology, there was no dearth of resources. The resources to deliver lectures included blackboard, zoom, or skype. For labs, some of the options were no labs, or remote lab access with VPN after porting labs from hardware to software or providing hardware kits to students for remote lab work. Office hours could be offered either via skype, blackboard or zoom. Exams could be given either over zoom, skype, prairie learn, gradescope, blackboard or ProctorU. Exam format could be open book, take home, multiple choice or essay type questions. Exam submission could be scanning in either hand-written or typed document. Disruption due to COVID-19 pandemic happened in the middle of the Spring 2020 semester. For the courses that were being offered in traditional face-to-face mode, the challenge was to select the best possible method of course delivery with least effort, inconvenience and time spent on training course staff, and students.

This paper reviews the online teaching methods that were available at our university. It provides justification for using the chosen online platforms over others for delivering the course- *Introduction to VLSI Design*. Online teaching was found to be more effective over face-to-face based on comparison of student grades and course evaluations. The paper identifies the problems encountered during online teaching and the steps taken to mitigate them. Further, we highlight how the lessons learnt during the Spring 2020 semester were used to improve teaching methodology during the Fall 2020 semester.

2. Introduction

Covid-19 pandemic started in China but rapidly spread worldwide in the beginning of the year 2020. It is a highly contagious disease. To limit its spread, due to congregation of people at one place, lockdown was imposed in several countries including the US. In our university, option of no in-class teaching was offered after the spring break. The announcement was very sudden for most of the faculty and students. Students had to vacate their dorms and move to their homes or off-campus. Some students were from other countries. They were stranded in the US as flights to their home countries were suspended. They had to find alternative accommodations in the US outside the dorms. This led to a lot of mid-semester disruption in student life. They had to give up social activities, could not physically meet and help each other with course assignments. The faculty and teaching staff using traditional, face-to-face mode had to quickly switch to new modes of teaching.

There was a myriad of teaching modes available as some of the courses were being offered in flipped mode or were using newer online tools to ease grading work etc. To sift through these teaching tools and select the ones most suitable for teaching in a very short interval of time was indeed a challenge. It required all the labs, HW, exams, and office hours to be ported to the new platform. This meant the teaching staff as well as the students were required to learn new tools. With all the adjustments required in lifestyle, this was bound to add additional stress if a radically different approach to teaching was chosen. Thus, the goal was to choose a teaching delivery mode that was effective in delivering the content yet simple to learn quickly. Also, the exams, HWs and lab delivery were to be as close to normal times as possible so that no one was unduly burdened.

Given all the above constraints, it was decided to deliver lectures and office hours using the zoom platform. Lecture material was posted online on course website. HWs were submitted online on blackboard. Labs were conducted using remote log in to the labs through vpn. Exams were administered using zoom platform to preserve the format. The result of all these decisions was better student grades compared to those in the prior semester.

There were several problems encountered due to change in mode of delivery. Notable ones were zoom bombing, internet disruption in labs, student de-motivation due to lack of interaction among students, and lack of access to hardware like camera enabled PCs. These were all addressed.

Based on our experience in this semester, we learnt that using several different platforms – course website, zoom, remote labs, blackboard could cause confusion. Therefore, in the Fall 2020 semester, when courses were again delivered online, a single platform, viz., blackboard was utilized for lecture delivery, labs, HW, and exams. The labs were ported to a free software (PSPICE) that could be downloaded on student machines for free. The students did not have to log in to the department labs remotely, thus, minimizing chances of disruption.

3. Background

The following paras highlight how the course, *ECE425: Introduction to VLSI design* was being delivered pre-lockdown and the different online teaching tools available for use at the University. Pre-covid, this course was being delivered in the traditional mode.

A. Lectures

In pre-covid times, the course was being delivered in traditional face-to-face lecture mode using power point slides and projection on-screen. The lecture notes were posted on course website. Post-covid lockdown, there were various options – deliver lectures using zoom or skype (synchronous mode) or record lectures and post them for students to view on their own and utilize the class time to work on problems (flipped mode). Another modality for lecture delivery was echo 360 in classrooms, where the instructor could deliver lecture in a classroom equipped with this system and students could either attend lectures in person or view recording or both. The university had license for zoom, skype and echo 360. Using any of these would not add to the cost of course delivery. So, the decision to select the most appropriate mode was based on convenience of use for students and instructors. Some of the minor decisions were whether to

keep the video on for speaker and participants or for either, whether to allow students to post in chat or allow them to ask questions by raising their hand, or pause in the lecture and ask students for questions and whether to make student attendance compulsory.

B. Office hours

In pre-covid times, the office hours were conducted in person in the instructor or teaching assistant's office. Post-covid lockdown, the options considered were zoom and skype. It was surprising to realize that students did not know how to use skype for meetings. We considered skype to be more convenient to use. Because, one could just log into skype on one's machine and wait for students to ask questions. It would have been easier for students to ask questions anytime the instructors were logged into skype on their personal computer. But students did not want to use skype, or perhaps could not use it.

C. Labs

In pre-covid times, the four lab exercises leading to the course project were completed on cadence terminals in department labs with in-person help from teaching assistants. In post-covid times, in-person access to the labs was not allowed. Students had to complete the rest of the project in Cadence software as they had already used it for over half of the project. This software is expensive and big, so students could not install it on their own machines. Before lockdown, they used to submit their lab assignments in-person in class. Options available for Cadence use were to log in remotely using vpn and to hand in lab assignments either via email or blackboard.

D. Homework

Before covid induced lockdown, homework files were distributed through online website and solutions were handwritten and submitted in-class to the instructor. Post-covid, HW exercise distribution could be continued as is, but submission required changes. Available options for submission included emailing homework to the TA or instructor, or submission on blackboard. It would be difficult to manage so many email submissions. While if homework was submitted on blackboard, comments and grades could be provided there and student work could be retrieved at a later date.

E. Exams

This was perhaps the hardest decision. There was a myriad of options available viz., prairie learn, blackboard with proctorio, live video monitoring through zoom or skype or blackboard, gradescope, take home exams, replace exams with some extra project work. The following table provides a brief overview of the first 4 methods, their working, pros and cons. The rest are self-explanatory.

Table 1: Comparison of different platforms for administering exams [1],[2]

Platform	Working	Pros	Cons
Gradescope	<p>Instructor needs to upload a pdf and then convert it to an exam by pulling rectangles around each question and subpart of a question.</p> <p>Can create rubrics for positive and negative grading, can copy rubrics.</p> <p>Can easily add students to the roster using a .csv file.</p>	<p>Easy to grade – can grade each question of all students at the same time.</p> <p>Can use same rubrics for several students. Rubrics can be automatically upgraded for all the students.</p> <p>Can annotate directly on student submission.</p> <p>Students can submit a pdf file for the assignment.</p> <p>Easy to view assignment statistics.</p>	<p>More time to learn the software – for both instructors and students (around 30 minutes).</p> <p>Need to create rubrics.</p> <p>Students will need to submit assignment and identify each question separately.</p>
Prairie Learn	<p>Need to create each question separately in the software using several different files like image files, python code file. Some level of expertise is required for the instructors.</p>	<p>Can generate several versions of a question by changing values of variables randomly.</p> <p>Can calculate answers to questions with code provided by the instructor.</p> <p>Can auto grade so very little or no time spent on grading.</p> <p>Suitable for multiple choice question type exams or assignments.</p>	<p>Takes a lot of time to create questions.</p> <p>Needs training for instructors to create the questions (over an hour long).</p> <p>Needs knowledge of coding, html – at least the basics.</p> <p>Prone to errors in case answer is not input in the exact same format.</p>
Proctorio	<p>Students are required to download an app in blackboard.</p> <p>Instructor needs to create an exam in blackboard.</p> <p>Proctorio can record and report any suspicious activity of a student taking the online exam.</p>	<p>Can detect suspicious activity.</p> <p>Similar in complexity to zoom based or blackboard-based exams so little or no additional training required.</p>	<p>Harder to examine students working on problems by hand – more suited to problems that are entered on computer like multiple choice questions.</p> <p>Students find it intrusive as it can access other data on their computers.</p>

Live video monitoring with blackboard or zoom or skype	Instructor creates a meeting in zoom/skype/blackboard, all students log into the meeting with their videos turned on and solve exam in front of camera.	Easy to learn, closest to the traditional mode, but avoids covid risk associated with coming to an actual classroom.	Students required to have video capability on their computer/device.
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4. Teaching methods used for the VLSI design course

The Introduction to VLSI design course involved traditional or face-to-face teaching in non-COVID times. By the time lock down due to covid was announced, it was mid-semester and the midterm was already over.

After the lockdown, lectures were moved to zoom platform. Link to the zoom meetings was posted online on course website. This move was not very tedious; other than the need to learn zoom. It enabled interaction similar to that in classroom. Therefore, it was easy for students and instructors to adapt to. The students could switch off their videos, no compulsory attendance, they could ask questions when the instructor paused during the lecture or after the lecture or in the chat window. One such example of teaching over zoom is shown in the picture below.

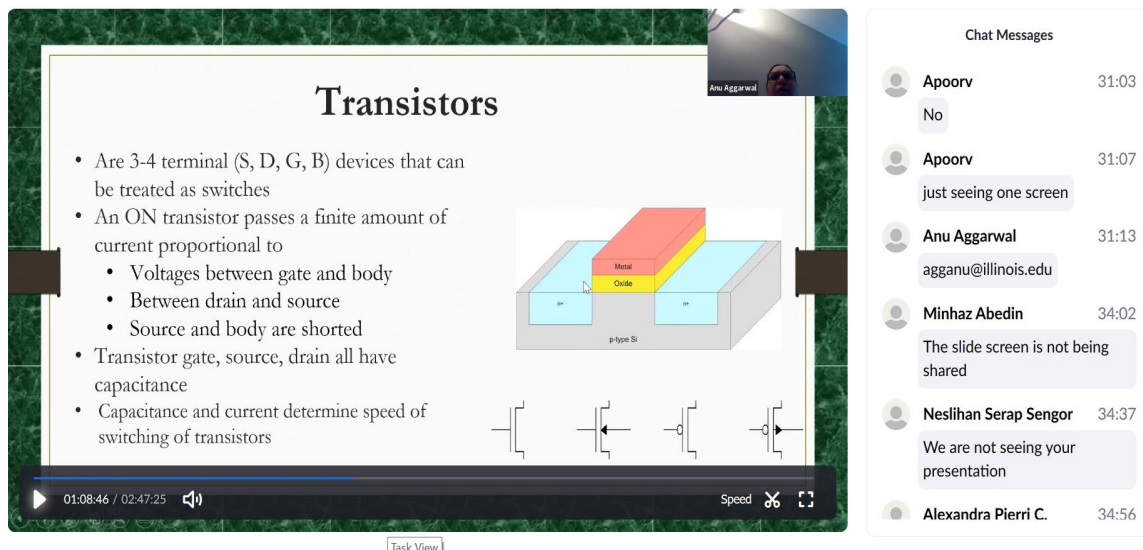


Fig. 1 Example of teaching online on zoom

Since students did not want to use skype for office hours even though the instructor did, another set of zoom meeting was created to offer office hours to students.

Labs were software based, so porting them to virtual platform with access through vpn was the only option available. Since, students had access to help from teaching assistants before disruption, similar help was provided over zoom. Lab submission was moved to blackboard instead of in-person, in-class submission. This enabled students to check the grades and

comments on assignments as soon as they were posted. The softcopy of graded assignments could also be accessed later, if need be.

Homework exercises continued to be posted online on course website. Students continued to solve homework in pen and paper. The submission of homework was moved to blackboard (from in-class submissions before the lockdown). The students scanned their handwritten homework and submitted online on blackboard. This eliminated the need to create homework in new format, thus, less work for the teaching staff. This also eliminated the need for students to learn a new way of doing homework. The only change was that students had to submit a scanned copy of the homework online but that had some advantages as well. They had immediate access to graded solutions, that were available to them throughout the course. The instructors could also retain a copy of student solutions for future reference.

Before covid-induced lockdown, exams were conducted in person in the classroom. Post-covid lockdown, the exams were moved to zoom. Exam questions were posted online on blackboard, students could download them and attempt the questions on paper while sitting in front of a phone/laptop camera over zoom. This method was chosen since the students did not want to use more intrusive software like proctorio. Also, we wanted to give a non-multiple-choice question exam that students could hand write. We wanted to monitor the students while they were taking the exam to allow them to ask questions and to ensure fairness during the exam. Once students finished the exam, they had to scan it and upload it to the designated place on blackboard. They were provided extra time for the additional activities – printing the exam, scanning it and uploading it back to the blackboard. This approach saved time required for learning new platforms and ensured the exams were conducted very close to the pre-covid format.

5. Problems encountered

Meetings were disrupted during lectures due to internet disruption. Zoom bombing was a problem while using zoom. There were unauthorized users trying to access the meetings.

Disruption in labs due to vpn (virtual private network) getting overloaded was a constant problem. At times, the vpn would not work, other times the internet would not work or there will be other issues with lab access as all the students were trying to log in at the same time.

Student attendance was low for some of the initial lectures. Some students felt totally demotivated due to lack of in-person student activities and the myriad adjustments required to adapt to the new situation. They faced loneliness due to lack of social activity and inability to meet other students in-person for group study or group work.

During exam, some students could not keep their cameras on for the entire duration. They had to leave their place to take print out of the exam and scan it at the end. But these were for a very short duration so were not considered significant enough to warrant any action.

6. Steps taken to overcome the problems

Video recordings of lectures were posted online to take care of disruptions due to internet irregularity. To avoid zoom bombing, the zoom meetings were password protected, only authorized users could log into the meeting.

To enable students to complete labs without losing points, they were allowed flexible submission deadlines. It was feared that this might lead to tardiness among the students, but it did not. They completed and submitted the work as soon as they were able to, given the extension.

Continuous motivation was provided to students. They were told that they were lucky to be able to continue classes even with the covid situation and to graduate on time. They were encouraged to help each other and make online peer groups as their support system. Students responded well to this encouragement and empathy.

No major problems were encountered in conducting exams.

7. Advantages of online teaching

There are several advantages to online teaching – reduced pressure for classrooms and offices on the department, reduced stress to commute. Students did not have to pay for separate housing. They could stay with their family with much less worries of taking care of their basic needs. They could use the home office printer, desktop and laptop for their lectures, so no additional gadgets were required. They could take exams in a more relaxed environment while eating and drinking on the side. They could access lecture videos online after the lecture. This helped them review lectures at a time convenient to them. Instructor could conveniently store a copy of all the exams, HW, labs and project materials submitted online in digital form. Else, a hardcopy of the assignment would have to be stored for at least until student graduated (could be 4-5 years!).

In non-covid times, the university conducts student evaluations in writing. Thus, it is hard to access detailed results. But during this semester, student evaluations were conducted online. So, instructors could access the results as soon as exam grading was complete. These results will be accessible to the instructors for a long period.

8. Comparison of student performance to prior semester

There could be different ways to evaluate efficacy of this mode of teaching to the traditional mode. But student grades were chosen here as the goal of teaching is to help students learn. And grades are a measure of learning. Moreover, we had access to grades for this semester (Spring 2020) and those for the previous semester (Fall 2019). During the Fall 2019 semester, the course had similar variety (undergraduate/ graduate) of students enrolled in it. There were pre-requisites for the course, so the students were expected to have similar preparation before enrolling in the course. In this semester, everything was like that in the prior semester, viz., course materials, HW, labs, project and exams except that the course was partly delivered online. It was observed that in the current semester, more students secured A grades than the prior semester. Some students also secured A+ grade, as compared to no A+ grades in the previous semester. In the current semester, there were no F or C grades, only 10% secured D grade. In the previous semester, B grade was the most common, some C, D and F grades were also assigned. Overall, there was better student performance in the semester.

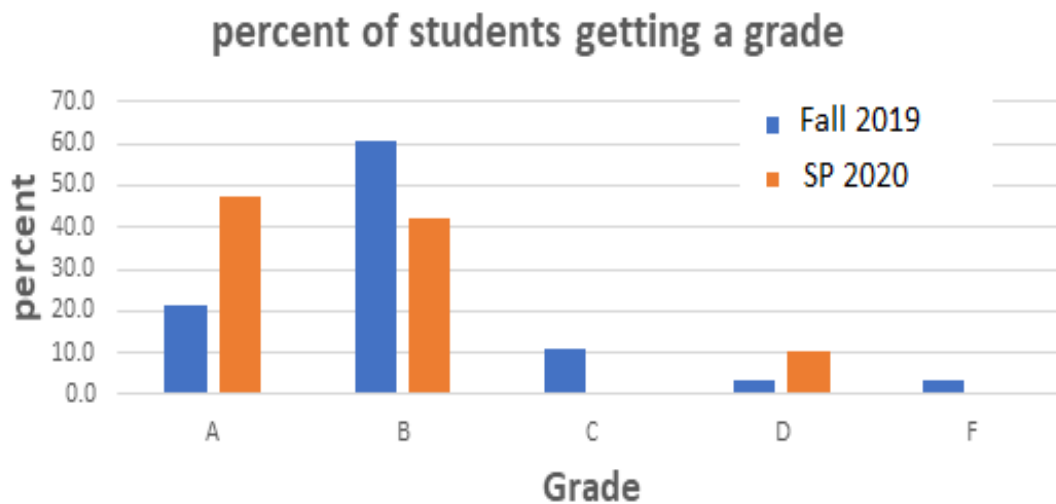


Fig. 2 Student grades for the course (ECE425) with and without online delivery.

This led to better instructor evaluation as compared to the previous semester.

9. Improvements made in future semesters based on lessons learnt

Even though teaching during Spring 2020 semester was successful as far as better student and instructor performance was concerned, several different platforms like zoom, course website, black board and lab access over vpn were used for course delivery. This caused some confusion among students and instructors. Therefore, in Fall 2020 semester (still affected by covid), it was decided to deliver the course over a single platform, viz, blackboard. As such, zoom links for lectures, office hours and exams were posted on blackboard, all lecture notes, recordings, HWs, labs, project and exams were delivered through blackboard. Labs were moved to a platform that was free (PSPICE) to students and could be installed on their laptops. So, problems encountered due to remote log in were not there. This was reflected in better student performance and better instructor evaluations in the Fall 2020 semester than in the Spring 2020 semester. In this semester, 80% of the students secured an A and the rest secured a B grade, none secured a C or a D grade.

10. Conclusion

It was challenging for both the students and the instructors to move teaching from face-to-face to online mode within a couple of days. There was a lot of COVID-associated fear and dislocation for the students. Based on outcomes like student grades and instructor course evaluations, online teaching using zoom, course website, blackboard and vpn access to remote labs seems to have worked well. However, there was scope for further improvement by integrating all the deliverables onto single platform, i.e., blackboard. This was experimented with during the Fall 2020 semester. Based on the success of this approach, we would strongly advocate use of in-person online teaching over face-to-face conventional teaching mode. A reason for success could be that the engineering students are more technology savvy so it is easier to move classes online. Alternatively, it might be because students saved commute time and used it for course work. Or

because they were better off staying at home with less worries. Or due to availability of recorded lectures for the students to review in their own time.

11. References

[1] Teaching courses online from the Illinois website <https://atlas.illinois.edu/teaching-online>

[2] Remote teaching technologies from Illinois website <https://remote.illinois.edu/teaching-tools-and-technologies>