

**COMPARING THE EFFECTIVENESS OF ONLINE AND FACE-TO-FACE
TEACHING AND LEARNING METHODS IN AN ENGINEERING COURSE DURING
AND AFTER THE COVID-19 PANDEMIC**

**Diana Che Lat^{1*}, Doris Asmani Mat Yusof¹, Nurul Ainain Mohd Salim² & Roslizayati
Razali¹**

**¹Civil Engineering Studies, College of Engineering, UiTM Johor Pasir Gudang
Campus, 81750, Masai, Johor**

**²School of Civil Engineering, College of Engineering, Universiti Teknologi MARA Shah
Alam Campus, 40450, Selangor, Malaysia
(Corresponding author: dianacl@uitm.edu.my)**

Abstract

The horrific COVID-19 pandemic that took many lives stunned the entire world. To prevent the extremely hazardous COVID-19 infection, all work, including the teaching and learning process, had to be completed online. In order to make learning and teaching successful and accessible to school and university students, teaching and learning techniques have also undergone a drastic transformation. This is achieved through the use of online platforms. In this study, a case study was conducted based on Engineering Course at one of Malaysian university for three course codes, for three semesters during COVID-19 and two semesters after COVID-19. The three course codes are Soil Engineering, Water and Wastewater Engineering, and Concrete and Steel Design. A comparison of teaching and learning assessment methods during and after COVID-19 semesters is described in this study. The effectiveness of online versus face to face teaching and learning was examined by analyzing the assessment grades of university students involved, with a total of 111 to 283 students every semester. Overall, there was a drastic decrease in assessment grades for semesters that experienced a change in the teaching and learning process from online to face-to-face.

Keywords: COVID-19; engineering; face to face; online; teaching and learning

Abstrak

Pandemik COVID-19 yang mengerikan yang meragut banyak nyawa mengejutkan seluruh dunia. Untuk mengelakkan jangkitan COVID-19 yang sangat berbahaya, semua kerja, termasuk proses pengajaran dan pembelajaran, perlu dilakukan secara dalam talian. Untuk menjadikan proses pengajaran dan pembelajaran berjaya dan boleh diakses oleh pelajar sekolah dan universiti, teknik pengajaran dan pembelajaran juga telah mengalami perubahan yang drastik. Ini dicapai melalui penggunaan pelantar dalam talian. Dalam kajian ini, kes kajian adalah diambil berdasarkan subjek kejuruteraan untuk tiga subjek bagi tiga semester semasa COVID-19 dan dua semester selepas COVID-19. Tiga subjek tersebut adalah Kejuruteraan Tanah, Kejuruteraan Air dan Air Kumbahan, dan Rekabentuk Konkrit dan Keluli. Perbandingan kaedah penilaian pengajaran dan pembelajaran semasa dan selepas semester COVID-19 diterangkan dalam kajian ini. Keberkesanan pengajaran dan pembelajaran dalam talian berbanding secara bersemuka diteliti dengan menganalisis gred penilaian pelajar, dengan jumlah pelajar seramai 111 hingga 283 setiap semester. Secara keseluruhannya, terdapat penurunan gred penilaian yang drastik bagi semester yang mengalami pertukaran proses pembelajaran daripada secara dalam talian kepada secara bersemuka.

Kata kunci: Bersemuka; COVID-19; dalam talian; kejuruteraan; pengajaran dan pembelajaran

1.0 INTRODUCTION

The World Health Organisation (WHO) declared the COVID-19 outbreak as a public health emergency of global concern on January 30, 2020. The biggest worry for World Health Organization (WHO) was that the virus would spread to nations with less developed health systems, making them unprepared to handle the outbreak (WHO, 2020). The COVID-19 epidemic caused widespread upheaval around the world, making 2020 a remarkable year. In many areas, including healthcare system, the economy, and education, governments and other institutions had to adjust to unanticipated problems. Consequently, a great deal of educational establishments moved swiftly to remote learning also referred to as e-learning, online learning, or virtual classrooms in order to guarantee their students' continuous access to classes (Alarifi & Song, 2024).

Over than hundreds of Public and Private Higher Education Institutions in Malaysia decided to shift to online classroom in place of physical classroom instruction during the COVID-19 pandemic. The process of learning could not be operating as usual. The current physical class must be done online using a variety of educational technologies (Sumitra & Roshan, 2021; Sukendro et al., 2020). The virus spread to Malaysia has affected the

government's decision to implement a lockdown, which influenced the community's lack of physical activity and increased the use of smartphones and televisions for screen time (Bram et al., 2020; Castañeda-Babarro et al., 2020; Derek et al., 2021). The learning process could never again take place face-to-face in the classroom; therefore, the educator would have to drastically change their previous approach to online learning (Huaijin et al., 2022). Since students and educators were unable to communicate face-to-face during the pandemic, the closure of educational institution broke the COVID-19 virus distribution. It is anticipated that the COVID-19 epidemic may end quickly when the online study guidelines are implemented (Edgar, 2020). It was difficult for educators to teach using a manner that was unfamiliar and out of the ordinary. To address these problems and ensure that students are still learning despite the pandemic, effective teaching strategies has been implemented (Matsushita et al, 2022; Matsushita et al, 2022). The teaching method was changing drastically; it was virtual and conducted from home (Minhyun et al., 2021), and teachers all around the world uses new technologies that have emerged (Pavlou & Tsihclas, 2023; Waleed et al., 2023; Le et al., 2023).

Following the COVID-19 pandemic for nearly three years, the WHO announced that the virus was no longer a global health emergency. After almost three years of the COVID-19 pandemic, Malaysia was able to successfully contain the outbreak with its vigorous reaction. The prime minister declared in March 2022 that the nation will enter the endemic phase in April 2022 (Joseph, 2022). In consideration of the widespread COVID-19 epidemic, most of Malaysian educational institutions are permitted to return to their campuses and start performing face-to-face classes, as per the directive of the Ministry of Higher Education. As a result, starting in October 2022, the School of Civil Engineering at UiTM was switching some of its education system from online to physical classroom and the students started physical classroom and assessments as before COVID-19. Student performance data based on assessments from September 2019 to February 2024 are the main focused in this primary study in order to compare the effectiveness between online and face-to-face teaching and learning during and after the pandemic. This is because these two specific time periods are important periods for students to normalize the transition of assessment style from online to face-to-face.

2.0 MATERIALS AND METHODS

This research encompassed five semesters spanning periods during and after COVID-19 session. Data was collected from assessment results of student during COVID-19 semester (online teaching and learning); Sept 2019 - Jan 2020 (Semester 20194), Sept 2020 - Jan 2021 (Semester 20204), Oct 2021 - Feb 2022 (Semester 20214), as well as during normal semester (face to face teaching and learning); Oct 2022 - Feb 2023 (Semester 20224) and Oct 2023 - Feb 2024 (Semester 20234) for three different courses. These courses were selected as to represent the core subject such as Soil Engineering (ECG353), Water and Wastewater Engineering (ECW331), and Structural Concrete and Steel Design (ECS338). During pandemic, teaching and learning were carried out through online distance learning (ODL). Once the pandemic concluded, the teaching and learning process reverted entirely to face to face session.

2.1 Soil Engineering (ECG 353)

This course deals with the application of basic soil mechanic principles to civil engineering works. It covers topics on vertical stresses distribution in soils, lateral earth pressure, bearing capacity of soils, slope stability and subsurface soil exploration. According to the syllabus, the assessment is divided into a test (30%) and open assessment (10%) making up 40% of the total marks of the total continuous assessment marks. The final examination accounts for 60% of the total grade, covering all course topics. Table 1 list out the continuous assessment breakdown during normal semester.

Table 1. Assessment breakdown for ECG 353 during normal semester

| Continuous assessment | Marks |
|-----------------------|-------|
| Test | 30% |
| Assignment | 10% |
| Final examination | 60% |
| Total | 100% |

During COVID-19 semester, the assessment was changed to different pattern in order to adapt with the online teaching and learning session. The final examination was replaced by two assignments that contribute to 60% of total marks, and the other 40% of marks contribution was covered by 30% test and 10% quiz. The test was conducted in a synchronized manner, with students receiving test question using online platform. The question can only be assessed on the set date and time for limited time according to student learning time (SLT). Students were given two hours to complete the test, after which they had to upload their answer script through the online platform. If students were unable to upload their answer using the abovementioned medium, they could submit their answer script either using WhatsApp, Telegram or by email to their lecturer. The same procedure was followed for submitting assignment and quizzes. Table 2 illustrates the assessment breakdown for ECG 353 course during COVID-19 semester.

Table 2. Assessment breakdown for ECG 353 during COVID-19 semester

| Continuous assessment | Marks |
|-----------------------|-------|
| Assignments 1 and 2 | 60% |
| Test | 30% |
| Quiz | 10% |
| Total | 100% |

2.2 Water and Wastewater Engineering (ECW331)

This course covers three area namely hydrology, water and wastewater engineering system. The study of water engineering focuses on the sources of water supply, water demand, water quality and water treatment system. The study of wastewater engineering covers the introduction of conventional wastewater treatment system, environmental impact of wastewater and its effect on public health. Similar to ECG 353, the assessment breakdown as stipulated in the syllabus included test, assignment and final examination. The final examination contributes to the highest mark for the continuous assessment which is 60% meanwhile test and assignment give 30% and 10% marks respectively as shown in Table 3.

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Table 3. Assessment breakdown for ECW 331 during normal semester

| Continuous assessment | Marks |
|-----------------------|-------|
| Test | 30% |
| Assignment | 10% |
| Final examination | 60% |
| Total | 100% |

During the COVID-19 semester, the course underwent changes in the assessment format. Instead of the traditional assessment that was stipulated in the syllabus, assessment was modified to include assignments, test and projects as shown in Table 4. These assignment and projects were to be completed as group projects, requiring students to work in group. Submission of their work was flexible whereby students could upload their assignments and projects via email or google drive. For those who have limited internet access, they could alternatively submit their work through WhatsApp. Students were required to turn on their cameras during the entire test, which was administered online using platforms like Google Classroom and Microsoft Teams. This method can probably avoid students copying during test or discuss with their classmates.

Table 4. Assessment breakdown for ECW 331 during COVID-19 semester

| Continuous assessment | Marks |
|-----------------------|-------|
| Assignment | 10% |
| Test | 30% |
| Project 1 | 30% |
| Project 2 | 30% |
| Total | 100% |

2.3 Structural concrete and steel design (ECS338)

This course deals with the methods of analysis and design reinforced concrete and steel structures in accordance with the relevant standards. The normal semester assessment is similar to ECG 353 and ECW 331 which comprises of test (30%), assignment (10%) and final examination (60%) as stated in Table 5.

Table 5. Assessment breakdown for ECS 338 during normal semester

| Continuous assessment | Marks |
|-----------------------|-------|
| Test | 30% |
| Assignment | 10% |
| Final examination | 60% |
| Total | 100% |

Following the implementation of emergency measures and the transition from traditional face to face method of teaching to ODL, the assessment structure for ECS 338 was outlined in Table 6. The continuous assessment primarily consisted of assignments and quizzes with all assignments being conducted individually. Assignments were distributed to students through Whatsapp group/ Telegram/ Email or any other suitable platforms. Students were required to submit the assignment in PDF form through the online platforms. Meanwhile for quiz, the question will be set up using Google Quiz Form or any other suitable platform. Students will answer all questions within the time given. At the end of each quiz session, student will get their marks directly and will see the right answer for each question. The details information about the assignment breakdown for this course during COVID-19 semester are explained in Table 6.

Table 6. Assessment breakdown for ECS 338 during COVID-19 semester

| Continuous assessment | Marks |
|-----------------------|-------|
| Assignment 1 | 20.0% |
| Assignment 2 | 27.8% |
| Assignment 3 | 15.0% |
| Quiz 1 | 15.0% |
| Quiz 2 | 22.2% |
| Total | 100% |

3.0 RESULTS AND DISCUSSION

Tables 7, 8 and 9 show the total students and failure rate for course code ECG353, ECW331 and ECS338, respectively for five different semesters. Figure 1 shows a comparison of different batch student for five semesters with failure rate for all three courses: ECG353, ECW331 and ECS338. For the first three semester, the teaching and learning was online. The fourth semester showed the highest failure rate when full face to face was implemented after COVID-19 ceased. The fourth semester consisted of batch of student intake during pandemic COVID-19 whereby they faced online teaching and learning from the first semester. During online teaching and learning, student assessment was also online. This batch of student undergone online class until third semester. During fourth semester, they undergone face to face teaching and learning including assessments. From the graph of failure rate for different course code, it showed that this batch of student faced the highest failure rate during the fourth semester whereby this period is the transition between online and face to face teaching and learning. The three-course code is a hard-core subject whereby the highest percentage cover up the cognitive domain. During the first three semester, they faced with fully online assessment method. They are not familiar with face to face assessment at the university, thus many of them were not able to score the subjects.

Table 7. Failure rate for Code ECG353

| Semester | Total Students | Failure Rate (%) | Teaching/Learning/Assessment method |
|----------------------|----------------|------------------|-------------------------------------|
| Sept 2019 - Jan 2020 | 242 | 6% | Online |
| Sept 2020 - Jan 2021 | 274 | 1% | Online |
| Oct 2021 - Feb 2022 | 146 | 1% | Online |
| Oct 2022 - Feb 2023 | 120 | 45% | Face to Face |
| Oct 2023 - Feb 2024 | 207 | 17% | Face to Face |

Table 8. Failure rate for Code ECW331

| Semester | Total Students | Failure Rate (%) | Teaching/Learning/Assessment method |
|----------------------|----------------|------------------|-------------------------------------|
| Sept 2019 - Jan 2020 | 222 | 23% | Online |
| Sept 2020 - Jan 2021 | 283 | 2% | Online |
| Oct 2021 - Feb 2022 | 153 | 6% | Online |
| Oct 2022 - Feb 2023 | 117 | 34% | Face to Face |
| Oct 2023 - Feb 2024 | 211 | 17% | Face to Face |

Table 9. Failure rate for Code ECS338

| Semester | Total Students | Failure Rate (%) | Teaching/Learning/Assessment method |
|----------------------|----------------|------------------|-------------------------------------|
| Sept 2019 - Jan 2020 | 234 | 16% | Online |
| Sept 2020 - Jan 2021 | 264 | 2% | Online |
| Oct 2021 - Feb 2022 | 144 | 8% | Online |
| Oct 2022 - Feb 2023 | 111 | 47% | Face to Face |
| Oct 2023 - Feb 2024 | 225 | 14% | Face to Face |

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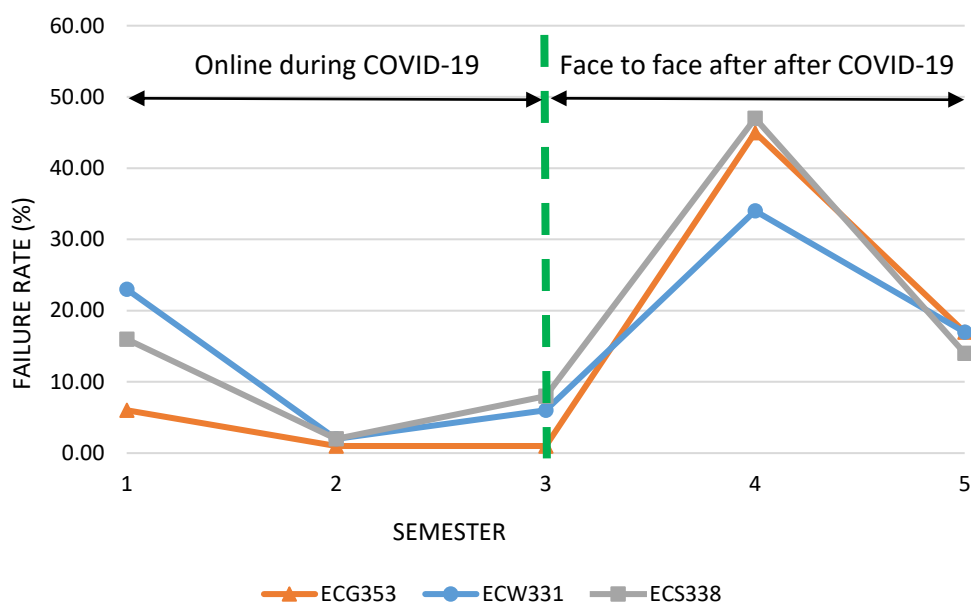


Figure 1. Failure rate (%) for different course code

4.0 CONCLUSION

Online teaching and learning are not as effective as face to face method as the students are not able to pay full attention during teaching and learning process. The assessment is online at their own home so that it is more to open book test. Comparing to face to face assessment, they carried out assessment in the lecture hall or classroom without bringing any reference books. Due to the online nature of the evaluation, students find it difficult to concentrate on the learning process since they anticipate that it would be administered similarly to an open-book assessment. As a result, they were unable to perform well on face to face assessments since their minds had been conditioned to the relaxed learning process for the first three semesters, leaving them unfamiliar with the challenging learning process. Because the online assessment can only be monitored by lecturer on a screen, students can still consult their books, which is why the assessment grade were better than those of the face to face assessment.

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