

Comparison of Assessment Results Between Face-to-face and Online Teaching Modes for the Control Systems Course at the United Arab Emirates University

Addy Wahyudie¹

¹Electrical Engineering Department, United Arab Emirates University, F1 Building, PO Box 15551, Al Ain, UAE

Abstract - This paper studied the comparison between an online learning mode and face-to-face learning mode in the course of Control Systems (ELEC431) at the Department of Electrical Engineering of United Arab Emirates University, UAE. The observation was made from the offerings in Fall 2019 and Fall 2020, which represented the face-to-face and online learning modes, respectively. The assessment results showed that the online learning mode increase the attainment of learning outcomes based on the obtaining grade. The level of satisfaction from student for the course and its instructor was also increase during the online learning mode. It is expected that the face-to-face teaching mode will be offered after the pandemic crisis. However, it is recommended to keep certain aspect of online learning for face-to-face learning mode, such as recorded lecture, online office hour, and online tutorial.

Key Words: Online teaching, Education during pandemic, Control Systems, Assessment, Grade Distribution.

1. INTRODUCTION

During Covid-19 pandemic, many teaching institutions change its teaching mode from traditional face-to-face mode to an online teaching mode [1-4]. This period brings a good change to provide as comparison study between a traditional face-to-face and online learning modes.

This paper compares the attainment of two teaching modes, i.e. face-to-face teaching mode and learning teaching mode, for the course of Control Systems (ELEC431) at the Department of Electrical Engineering, UAE University. The course has been assessment in many different scenarios before, as stated in [5-6]. The similar study can be found in [7-10].

The paper is organized as follows. In the section of course description, we describe the detail of the course. We present and discuss the results in the section of Result and Discussion. Finally, we give the conclusion in the section of Conclusion.

2. COURSE DESCRIPTION

This study was conducted to compare outcome the assessment results for two different teaching mode, i.e., face-to-face and online learning. The course is conducted in every

Fall semester. It is usually divided into sections, which are sections 01 and 51. The following is the detail of the course

2.1 Sample Space

We analyze the course in the last two offerings. Therefore, four sections were observed. Table 1 presents the number of the students for the four sections and the type of teaching modes.

Table -1: Number in each sampled offering

Academic Year (Section)	Number of students	Teaching Modes
Fall 2019 (01)	37	Face-to-face
Fall 2019 (51)	36	Face-to-face
Fall 2020 (01)	57	Online
Fall 2020 (51)	32	Online

2.2 Course Description

The course catalogue for ELEC 431 can be found in UAE-U website, as the following: Control systems in the real world, feedback concept, modeling of electromechanical systems, block diagrams, steady-state error analysis, stability analysis, time-domain analysis of control systems, root-locus, frequency domain analysis of control systems, control systems design in the frequency domain (phase lead and phase lag compensation, Nyquist and Nichols charts), and proportional-integral-derivative (PID) control.

2.3 Course Learning Outcome (CLO) and Program Learning Outcome (PLO)

The CLOs are composed based on the course catalogue. The CLO have designed appropriately and gone through many necessary revisions to meet the ABET program-learning outcome (PLO) as follows:

1. Derive mathematical model of systems [a,e].
2. Analyze time response of the first order systems, second order systems, and higher order systems [c,e].
3. Simplify multiple subsystems [e].
4. Evaluate the stability of the closed-loop systems [c,e].
5. Evaluate steady-state error of systems [c,e].
6. Analyze systems using frequency techniques [a,c].
7. Design controller for systems [c,d,g].

The program-learning outcomes (PLOs) for the department of Electrical Engineering are stated as the following:

- (a) Ability to apply knowledge of mathematics, statistics, science and engineering principles. The mathematics knowledge includes linear algebra, vector algebra, partial differential equations, complex analysis, and probability.
- (b) Ability to design and conduct experiments safety, as well as to analyze and interpret data.
- (c) Ability to design electrical components, systems or process to meet desired specifications and imposed constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
- (d) Ability to work in teams including multidisciplinary teams.
- (e) Ability to identify, formulate and solve problems encountered in the practice of electrical engineering.
- (f) Understanding of professional and ethical responsibility.
- (g) Ability to communicate effectively orally and in writing.
- (h) Ability to understand the impact of engineering solutions in a global and societal context.
- (i) Recognition of the need for, and ability to engage in life-long learning.
- (j) Knowledge of contemporary issues.
- (k) Ability to use the techniques, skills, and modern engineering tools necessary for electrical engineering practice.

2.4 Tentative Schedule and Detail of the course Content

The tentative weekly schedule to accomplish the course content is depicted in Table 2.

Table -2: Tentative Weekly Schedule

Week	Session content	Assignments
Week 1	Topic: Introduction to control systems Content: History of control systems; systems configuration; Analysis & design objectives.	-
Week 2	Topic: Modeling in frequency domain Content: Laplace transform; Transfer function; Transfer function for electrical & mechanical systems.	HW 1
Week 3	Topic: Modeling in time-domain Content: State-space representation; Converting state-space to transfer function and vice-versa.	HW 2 & Quiz 1

Week 4	Topic: Time response Content: Poles, zeros, and system response of first order system.	Quiz 2
Week 5	Topic: Time response Content: System response of second order systems; Higher order systems; System response with zeros.	HW 3
Week 6	Topic: Stability Content: Routh-Hurwitz criterion; Routh-Hurwitz criterion for special cases.	Quiz 3 and HW 4
Week 7	Topic: Reduction of multiple subsystems Content: Block diagram reduction.	Quiz 4
Week 8	Topic: - Content: -	Test 1 & Midterm
Week 9	Topic: Reduction of multiple subsystems Content: Block diagram reduction (Cont.).	HW 5
Week 10	Topic: Steady-state error Content: Steady-state error for unity/non-unity feedback systems; Static error constant and system's type.	HW 6 & Quiz 5
Week 11	Topic: Frequency response techniques Content: Bode plot and Nyquist diagram.	HW 7 & Quiz 6
Week 12	Topic: PID and design via root locus Content: The concept of PID; Ideal PI design.	HW 8 & Quiz 7
Week 13	Topic: PID and design via root locus Content: Ideal PD design.	HW 9 & Quiz 8
Week 14	Topic: PID and design via root locus Content: Lead and Lag compensators.	Quiz 9
Week 15	Topic: Project Content: -	Test 2 & Presentation
Week 16	Topic: Review Content: -	

2.5 Assessment Tools

The CLOs were measured quantitatively based on students' performances in the course through the designed assessment tools. These assessment tools are shown in Table 3

Table -3: Assessment tools and its percentage contribution

Activities contribution to grades	% Contribution
Weekly Homework	5%
Quizzes	5%
Project	10%
Test 1 (before midterm)	10%
Test 2 (after midterm)	10%
Midterm exam	25%
Final exam	35%

The weights in the Table 3 are appropriate and proportional to the time student get for the preparation and the level of difficulty. The final exam and midterm exam have the highest weights of 35% and 25%, respectively. They are comprehensive exams and cover complete course material through during semester. In this course, we divide the covering material for the midterm (and its Test 1) and final exams (and its Test 2) for reducing the load for the students. The material for the midterm is covering the CLO #1 to CLO #3. These CLOs will not be assessed again the final exam.

2.6 Face-face Teaching Mode

The face-to-face teaching mode is a traditional teaching mode for the course before the pandemic. It is conducted in a classroom and equipped with the smart classroom technology. The final examinations were conducted under surveillance of two proctors.

2.5 Online Teaching Mode

The online teaching mode was conducted using the Blackboard system. The classes are held using The Blackboard collaborative ultra. All lectures were recorded so that the student can easily access the previous lectures. The assessments are conducted in the Blackboard system. The assessments equipped with the Respondus (a proctoring system) and Lockdown browser to avoid cheating. The Respondus system requires face and ID identification. It raise a flag if it identified suspicious movement. The Lockdown browser locks the students' browser during the assessments.

3. Results and Discussions

The results of the learning processed is evaluate by observing the grade attainment in the offering. UAE-U adopts the grading system as depicted in Table 4. There are 12 letters of grade and it is ranging from A (excellent) to F (fail). To simplify the analysis for analyzing, the grades are grouped into 5 only, i.e., A, B, C, D, and F. In this group, the grade of A and A- are simply define as A, and it is applied for the other grade.

Table -4: The grading system

Grade	Point obtain
A	90-100
A-	87-89
B+	84-86
B	80-83
B-	77-79
C+	74-76
C	70-73
C-	67-69
D+	64-66
D	60-63
F	0-59

The results of the two years offering are presented in Table 5. From the table, there was clear improvement of student's performance. In the year where the online learning was held (2021), there number of students whose has grade C and above was increasing. There is no fail student in Fall 2021.

Aside from assessment for the attainment course to its obtaining grades, the questioner was conducted to study the student opinions regarding the course and its instructor in each offering. There are two tolls for this purpose, which are the course comparative analysis and instructor comparative analysis. The students fill the questioners before they take the final exams. The result of the questioners is depicted in Table 5 and 6 for Fall 2019 and Fall 2020. The score is based on the range of 1 (very unsatisfied) to 5 (excellent). In overall, the students have a positive feedback regarding the course and its instructor. However, the average of result in the online mode was higher compare to face-to-face teaching mode.

There are possibility reasons why the online teaching mode has a higher attainment compare to the face-to-face mode. The recording feature in teaching mode was really helpful, the student can easily revise their knowledge by referring to the recording. The office hour and additional tutorial can be easily established using an online meeting tool. The instructor did not get effected or distracted by the size of the class since it is online.

Table -5: Grade distribution

Academic Year (Section)	Grade obtained: number of student (percentage)
Fall 2019 (01)	A:13 (35%), B:14 (38%), C:4 (11%), D:2 (5%), F:4 (10%)
Fall 2019 (51)	A:11 (31%), B:11 (31%), C:8 (22%), D: 5 (14%), F: 1 (3%)
Fall 2020	A:24 (33%), B:25 (34%), C:12(16%), D:7 (10%), F:5 (7%)
Fall 2020 (01)	A:16 (28%), B:26 (46%), C:13(23%), D:2 (3%), F:0 (0%)
Fall 2020 (51)	A:19 (59%), B:9 (28%), C: 3 (9%), D:1 (3%), F:0 (0%)
Fall 2021	A:35 (40%), B:35 (40%), C:15 (17%), D:3 (3%), F:0 (0%)

Table -6: The students’ survey for the instructor comparative analysis

Question	Fall 2019		Fall 2020	
	Section 01 (Mean)	Section 51 (Mean)	Section 01 (Mean)	Section 51 (Mean)
The instructor was always well prepared for classes	4.46	4.64	4.50	5.00
The instructor made effective use of the class time	4.54	4.55	4.61	5.00
The instructor communicated the course outcomes	4.62	4.64	4.56	5.00
The course outcomes were achieved	4.54	4.45	4.61	5.00
Various teaching methods were effectively implemented	4.38	4.55	4.39	4.43
Students were encouraged to ask questions, participate and raise interest in the course subject	4.54	4.73	4.56	5.00
Students were encouraged for independent and critical thinking	4.23	4.55	4.67	5.00
The instructor provided clear and constructive feedback on assessment tasks	4.38	4.55	4.33	5.00
The instructor was available during the office hours	4.46	4.55	4.33	4.57
Different methods were used to evaluate the students’ performance (assignments, quizzes, projects, exams, etc.)	4.77	4.73	4.33	5.00
The instructor evaluated students fairly	4.46	4.36	4.56	5.00
The instructor treated students with respect	4.69	4.73	4.50	4.86
The instructor delivered this course with high standards	4.46	4.55	4.50	4.86
Overall mean	4.50	4.58	4.50	4.90
Yearly mean	4.54		4.70	

Overall, the course was of high quality	4.54	4.55	3.39	5.00
Overall mean	4.34	4.58	4.47	4.90
Yearly mean	4.46		4.70	

4. CONCLUSIONS AND RECOMMEDATIONS

From comparing the results of the two teaching modes, the online learning has resulted a more satisfying result compare to the face-to-face learning mode. UAE-U would resume the face-to-face learning mode in Fall 2021. It would be recommended to keep certain aspect of the online learning mode in face-to-face learning mode, such as recorded lecture and online office hours. It is expected that the combine features of these teaching mode will give a maximum attainment of course learning outcomes.

REFERENCES

- [1] R. Ferdig, E. Baumgartner, R. Hartshorne, et all, “Teaching, Technology, and Teacher Education During the Covid-19 Pandemic: Stories from the field”, AACE-Association for the Advancement of Computing in Education, 2020.
- [2] L. Neuwirth, S. Jovic, and B. Mukherji, “Reimagining Higher Education During and Post-COVID-19: Challenges and Opportunities”, Journal of Adult and Continuing Education, 2020.
- [3] L. Mishra, T. Gupta, and A. Shree, “Online Teaching-Learning in Higher Education during Lockdown Period of COVID-19 Pandemic”, International Journal of Education Research, vol. 1, 2020.
- [4] J. Qadir and A. Al-Fuqaha “A Student Primer on How to Thrive in Engineering Education during and Beyond COVID-19,” Education Sciences, vol. 10, issue 9, no. 236, 2020.
- [5] A. Wahyudie, “Impact of using e-Textbook for the Teaching of Control Systems Engineering in the United Arab Emirates University”, International Research Journal of Engineering and Technology, vol. 6, Issue 3, pp. 3490-3493, 2019.
- [6] A. Wahyudie, “Assessment Result and Analysis on Teaching Control Systems Course (ELEC 431) in the Electrical Engineering Department (United Arab Emirates University),” International Journal of Engineering and Applied Sciences, Vol. 4. Issue 7, pp. 30-34, 2017.
- [7] S. Hubackova and I. Semradova, “Comparison of on-line Teaching and face-to-face Teaching”, Procedia-Social and Behavioral Sciences, vol. 89, pp. 445-449, 2013.

Table -7: The students’ survey for the course comparative analysis

Question	Fall 2019		Fall 2020	
	Section 01 (Mean)	Section 51 (Mean)	Section 01 (Mean)	Section 51 (Mean)
The course material was effectively organized	4.46	4.55	4.50	4.71
The course activities and assignments were helpful in learning	4.31	4.64	4.33	4.71
The course workload was acceptable	4.00	4.73	4.56	4.86
The course content addressed real-life experiences	4.38	4.45	4.39	5.00
The course helped me to improve my thinking skills	4.31	4.45	4.56	5.00
The course added to my knowledge	4.38	4.73	4.56	5.00

- [8] B. Stern, "Comparison of of Online and Face-To-Face Instruction in an Undergraduate Foundations of American Education Course", CITE Journal, vol. 4, no. 2, 2004.

- [9] H. Shu and X. Gu, "Determining the difference between online and face-to-face student—Group Interactions in a blended learning course", The internet and Higher Education, vol. 39, pp. 13-21, 2018.

- [10] K. Rajab, "The effectiveness and Potential of E-Learning in War Zones: An Empirical Comparison of Face-to-face and Online Education in Saudi Arabia", IEEE Access, pp. 6783-6794, 2018.