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Comparison Study of Assessment Results for a Course Offered During and After Pandemic at the United Arab Emirates University

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Abstract - *This paper compared the students' attainment during and after the pandemic for the course of Special Topic in Power and Control Engineering at the department of Electrical and Communication Engineering, United Arab Emirates University. The course is an elective course. During the pandemic, the course was conducted using online teaching mode. After the pandemic, the face-to-face teaching mode was used, and the sessions were recorded. The attainment of was evaluated based on the students' grade. There was slightly decreasing of the performance after the pandemic. The questioners were distributed during and after the pandemic to evaluate the performance of the instructor and the course. The performance of the instructor increasing in the face-to-face sessions while the evaluation relating to the course remain the same in both teaching modes.*

Key Words: Education during and after pandemic, Course Assessment, ABET assessment, Online teaching, Face-to-face teaching, Grade Distribution.

1.INTRODUCTION

During the past three years worldwide experienced extreme changing in education due to before, during, and after pandemic. Before pandemic, majority relied on the traditional face-to-face teaching mode. During the pandemic, almost all academic institutions had been forced to conduct online teaching. Despite some pleas for supporting digital skills in the early of pandemic, as mentioned in [1-2], majority agreed that the online learning was effective [3-6].

It is interesting to know the trend of teaching mode after the pandemic. Many educational intuitions selected hybrid mode [7-10] combining both ace-to-face with some feature of the online teaching mode. Study in [11] reported that they prefer small private online class rather than the massive open online courses. Study in [12] was reported that they return to the face-to-face teaching mode and the performance of the student was decreasing due to new adjustment.

This study compared the performance of the students during and after the pandemic for the course of Special Topics in Power & Control Engineering in term of the students' grade and their opinion relating to the performance of the instructor and the course. The study aimed to show the data without drawing a specific conclusion relating to two offered periods. This because it is very difficult to draw the valid conclusion based on two offering only. During the pandemic, the online course was conducted while the face-to-face with recording during the session was conducted after the pandemic. The instructor keeps the recording of the face-to-face based on the recommendation from students that it is a useful feature during the online teaching mode [13]. The recordings made the student easier to get the missing information during the face-to-face sessions.

The paper is organized as follows. In the section of course description, we describe the detail of the course. The statical data were presented in the section of Result and Discussion. Finally, the conclusion was given in the section of Conclusion.

2. COURSE DESCRIPTION

The study was conducted for the Special Topics in Control and Power Engineering (ELEC530) course in the Department of Electrical Engineering at the United Arab Emirates University (UAE-U). The study was conducted during the pandemic (Spring 2021) and after the pandemic (Fall 2022). During the Spring, the teaching mode was online, while in the Fall, the teaching mode was back to face-to-face. The course was divided into two sections: 01 and 51, where the sections comprise male and female students, respectively. The detail of the number of students for the two offering semesters is stated in Table 1.

Table -1: Number students in the offering semesters.

Offered Semesters (Section/gender)	Number of Students	Teaching Modes
Spring 2021 (01/male)	31	Online
Spring 2021 (51/male)	40	Online
Fall 2022 (01/male)	21	Face-to-face
Fall 2022 (51/female)	34	Face-to-face

The online teaching mode was conducted using the Blackboard system. The classes were held using the Blackboard's Collaborative Ultra. All lectures were recorded so the student could easily access the previous lectures. The

assessments (the quizzes and the exams) were conducted in the Blackboard system. The assessments were equipped with the Respondus system (a proctoring system) and a Lockdown browser to avoid cheating. The Respondus system requires face and ID identification. It raises a flag if it is identified as a suspicious movement. The Lockdown browser locks the students' browsers during the assessments.

The face-to-face teaching mode was a traditional teaching mode for the course before and after the pandemic. It was conducted in a classroom and equipped with smart classroom technology. After the pandemic, the instructor keeps recording his lecture by using the Collaborative Ultra. The final examinations were conducted under the surveillance of two proctors and the class's instructor.

The course catalogue for ELEC 530 can be found in UAE-U website, as the following: Topics in power and control engineering are chosen by the instructor at the beginning of the term and approved by the department council. It was decided that the content of the course was the analysis and design of digital control systems. The content was mapped to the following course learning outcome (CLO):

CLO-1: Apply various theories and methodologies related to selected power and control systems [1].

CLO-2: Design using selected contemporary techniques for power and control systems [2].

CLO-3: Communicate major findings in the topics of power and control systems orally and in writing [3].

CLO-4: Discuss contemporary topics in the area for power and control systems engineering [5].

The numbers inside the bracket were the program educational objectives based on the ABET guidance [?]. The applied program educational objectives are:

1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering science, and mathematics.

2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.

3. An ability to communicate effectively with a range of audiences.

5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.

The CLO-1 and CLO-2 were further to be specified within the topics of digital control systems in the following learning objectives:

1. Understanding z-transform [CLO-1].
2. Write mathematical model for discreate systems [CLO-1].
3. Analyze stability for digital systems [CLO-1].
4. Design controller for digital systems using discreate transfer function [CLO-2].
5. Design controller for digital systems using discreate state-space [CLO-2].

For CLO-3 and CLO-4, the student was assigned a term project to discuss and present contemporary topics relating to application of digital control systems.

All CLOs were implemented throughout the semester using the weekly schedule of the course as depicted in Table 2.

Table -2: Weekly Schedule of the Course.

Week	Session content	Assignments
Week 1	**Topic: Introduction to digital control systems.** **Content:** The rationale for using digital control; The structure of digital control system. Example of digital control	-
Week 2	**Topic 2: Discreate-Time Systems** **Content:** Analog systems with piecewise constant inputs; Difference equations; The z-transform; Computer-aided design.	**HW 1**
Week 3	**Topic 2: Discreate-Time Systems.** **Content:** z-Transform solution of difference equations; the time response of a discreate-time system; modified z-transform; frequency response of discreate-time systems; sampling theorem.	**HW 2**

Week 4	**Topic 3: Modeling of Digital Control Systems** **Content:** ADC model; DAC Model; transfer function of ZOH; Effect of the sampler on the transfer function of a cascade; DAC, analog subsystem, and ADC Combination transfer function	**HW 3** **Quiz 1**
Week 5	**Topic 3: Modeling of Digital Control Systems** **Content:** Systems with transport lag; the closed-loop transfer function; the closed-loop transfer function; analog disturbance in digital systems; steady-state error and error constants; MATLAB Command.	**HW 4**
Week 6	**Topic 4: Stability of Digital Control Systems** **Content:** Definitions of stability; Stable z-domain pole locations; stability conditions.	**HW 5** **Quiz 2**
Week 7	**Topic 4: Stability of Digital Control Systems** **Content:** Stability determination; Jury Test; Nyquist criterion	**Quiz 4**
Week 8	**Topic:** - **Content:** -	**Midterm**
Week 9	**Topic 5: Digital Control Design** **Content:** Review on Analog Control Design using Root-Locus; z-domain root locus; z domain digital control design.	**HW 6** **Quiz 3**
Week 10	**Topic 5: Digital Control Design** **Content:** Digital implementation of analog controller design; Direct z-domain digital controller design; Finite settling time design.	**HW 7**
Week 11	**Topic 6: State-Space Representation for Discreate Systems** **Content:** Review on State-space representation for analog systems; Discreate state-space representation.	**HW 8** **Quiz 4**
Week 12	**Topic 6: State-Space Representation for Discreate Systems** **Content:** Discreate state-space representation; Property of state-space models	**HW 9**
Week 13	**Topic 7: State-Feedback Control** **Content:** Pole placement design; MATLAB implementation.	**HW 10** **Quiz 5**
Week 14	**Topic 7: State-Feedback Control** **Content:** Observer design; MATLAB implementation.	**HW 11**
Week 15	**Topic: Project** **Content:** -	**Quiz 6**
Week 16	**Topic: Review** **Content:** -	-

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
Homework	10%
Quizzes	20%
Group Project	10%
Midterm exam	30%
Final exam	30%

3. Results and Discussions

The learning process results were evaluated by observing the grade attainment in the offering. The university 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 analysis, the grades are grouped into five only, i.e., A, B, C, D, and F. In this group, the A and A- grades are simply defined as A, and it is applied to the other grade.

Table -4: The grading system.

Grade	Point obtains
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 decreasing of student's performances when the class went for face-to-face mode. The percentages of student who got grades of A and B were dropped.

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 6 and 7. The score was based on the range of 1 (very unsatisfied) to 5 (excellent). In Table 6. The students showed the increasing satisfaction for the performance of the instructor during the face-to-face session. However, the rating of the course was equal for both teaching mode as depicted in Table 7.

Attainment result in term of CLO for the course in Fall 2022 was shown in Table 8. The attainment result for Spring 2021 was not available as the CLOs has been modified between The two offering. The targeted rating was 7. All CLOs has been met expect for CLO 2, where it evaluated design aspect of the course. It seems that the student was very capable to analyze rather than to design. In the analyzing process, the student able to follow the systematic way to get the solution. However, the student was struggle in the design questions where it was requiring a rather heuristic way to get the answer. The instructor concluded that the level of understanding for the necessary concepts was not satisfied.

Table -5: Grade distribution for the course during and after pandemic.

Academic Year (Section)	Grade obtained: number of student (percentage)
Spring 2021 (01)	A: 20 (64%), B: 10 (33%), C: 0 (0%), D: 1 (3%), F: 0 (0%)
Spring 2021 (51)	A: 25 (61%), B: 11 (28%), C: 3 (8%), D: 1 (3%), F: 0 (0%)
Spring 2021	**A: 45 (63%), B: 21 (30%), C: 3 (4%), D: 2 (3%), F:0 (0%)**
Fall 2022 (01)	A: 10 (47%), B: 7 (33%), C: 4 (20%), D: 0 (0%), F: 0 (0%)
Fall 2022 (51)	A: 22 (64%), B: 6 (18%), C: 3 (9%), D: 3 (9%), F: 0 (0%)
Fall 2022	**A: 32 (58%), B: 13 (24%), C: 7 (13%), D: 3 (5%), F: 0 (0%)**

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

Question	Spring 2021		Fall 2022	
	Section 01 (Mean)	Section 51 (Mean)	Section 01 (Mean)	Section 51 (Mean)
The instructor was always well prepared for classes	4.36	4.71	5.00	4.50
The instructor made effective use of the class time	4.36	4.71	5.00	4.50
The instructor communicated the course outcomes	4.64	4.79	5.00	4.50
The course outcomes were achieved	4.55	4.64	5.00	4.50
Various teaching methods were effectively implemented	4.09	4.71	5.00	4.50
Students were encouraged to ask questions, participate and raise interest in the course subject	4.73	4.64	5.00	4.50
Students were encouraged for independent and critical thinking	4.55	4.64	5.00	4.50
The instructor provided clear and	4.09	4.64	5.00	4.50

constructive feedback on assessment tasks				
The instructor was available during the office hours	4.27	4.71	5.00	4.42
Different methods were used to evaluate the students' performance (assignments, quizzes, projects, exams, etc.)	4.64	4.71	5.00	4.50
The instructor evaluated students fairly	4.55	4.64	5.00	4.50
The instructor treated students with respect	4.36	4.79	5.00	4.50
The instructor delivered this course with high standards	4.55	4.71	5.00	4.50
Overall mean	**4.44**	**4.70**	**5.00**	**4.49**
Yearly mean	**4.57**		**4.75**	

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

Question	Spring 2021		Fall 2022	
	Section 01 (Mean)	Section 51 (Mean)	Section 01 (Mean)	Section 51 (Mean)
The course material was effectively organized	4.00	4.57	4.50	4.33
The course activities and assignments were helpful in learning	4.45	4.64	4.33	4.50
The course workload was acceptable	4.55	4.57	4.56	4.50
The course content addressed real-life experiences	4.27	4.50	4.39	4.50
The course helped me to improve my thinking skills	4.18	4.64	4.56	4.50
The course added to my knowledge	4.64	4.57	4.56	4.50
Overall, the course was of high quality	4.27	4.71	3.39	4.42
Overall mean	**4.34**	**4.60**	**4.47**	**4.46**
Yearly mean	**4.47**		**4.47**	

Table -8: Attainment result for CLOs of the course in Fall 2022.

Course learning outcomes	Attainment
1. Apply various theories and methodologies related to selected power and control systems	74%
2. Design using selected contemporary techniques for power and control systems	55%
3. Communicate major findings in the topics of power and control systems orally and in writing	100%
4. Discuss contemporary topics in the area for power and control systems engineering	100%

4. CONCLUSIONS AND RECOMMEDATIONS

The comparison study to evaluate the performance of the students for ELEC530 during and after the pandemic was conducted. In term of grade, the performance of the students was higher during the pandemic time where the teaching mode was online teaching. In contrary, the students showed the performance of the instructor after the pandemic was higher where the teaching was face-to-face. In term of the course, the student rated the online and face-to-face teaching mode was equal.

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