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Impact of using e-Textbook for the Teaching of Control Systems Engineering in the United Arab Emirates University

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Abstract - *This paper studied the impact of changing the medium of the textbook from hardcopy to e-book. The e-book is cheaper and handier compared to the hardcopy textbook. However, any changing needs a settlement time. This paper compared the grade attainments in the course of Control Systems (ELEC 431) in the Electrical Engineering Department of the United Arab Emirates University. The observation is conducted from the Fall 2015 until the Fall 2018. In first two offerings (Fall 2015 and Fall 2016), the student used the hardcopy of the textbook; while in the last two offerings (Fall 2017 and Fall 2018), the students used the e-book. The results show there is no significant change in term of the grades. Therefore, it is recommended to keep the usage of the e-book.*

Key Words: Impact of Textbook, E-Book, Hardcopy, Control Systems, Assessment, Grade Distribution.

1. INTRODUCTION

With advancement of information technology, the medium of learning has changed from hardcopy textbooks into the e-books. E-books offers a lot of advantages compared to hardcopy, such as cheaper price, handier in storage, simplicity in the logistic of the bookstore, etc. However, like any of the changes, user needs a settlement time.

The effect of the usage of e-books in education has been studied in many papers such as [1]-[6]. In this study, another study is conducted for the course of Control Systems (ELEC 431) in the Department of Electrical Engineering, United Arab Emirates University. UAE-U has adopted the usage of e-book for the majority of the course since 2017. In UAE-U, the textbook are provided by university and given free for the students.

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 find outcome the assessment results for two different classes (sections) for the same courses at the same offering. Here, we assessed the course for two offerings. The course is only offered once a year, which is fall semester. The following is the detail of the course

2.1 Sample Space

We analyze the course in the last four offerings. Table 1 presents the number of the students for the offerings and the type of the textbook.

Table -1: Number in each sampled offerings

Academic Year	Number of students	Type of Textbook
Fall 2015	24	Hardcopy
Fall 2016	37	Hardcopy
Fall 2017	30	E-book
Fall 2018	28	E-book

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 Appropriateness of the Textbook

The textbook of the course is Control Systems Engineering (6th edition) by Norman Nise (Wiley & Sons). The textbook is one of the best textbooks to teach the basic of control system engineering.

2.5 Assessment of the Prerequisite

The prerequisite of the course is ELEC 305 (Signal and Systems) and MATH 2220 (Linear Algebra and Engineering applications). ELEC 305 provides fundamental for the discussion in frequency domain, while ELEC 2220 gives fundamental for discussion in time domain.

3. Results and Discussions

The effect of using the textbook or e-book 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 four offering are presented in Table 5. From the table, there is no significant impact on using the hardcopy textbook or e-textbook.

Table -5: Grade distribution

Academic Year	Grade Distribution (Percentage)
Fall 2015	A (46%), B(33%), C(21%), D(0%), F(0%)
Fall 2016	A (16%), B(46%), C(30%), D(5%), F(2%)
Fall 2017	A (27%), B(30%), C(40%), D(3%), F(0%)
Fall 2018	A (54%), B(18%), C(14%), D(14%), F(0%)

4. CONCLUSION

From comparing the results in the last four offering, there is no significant change on the grade attainments for adopting the e-book. Since the e-book is cheaper and handier compared to the hardcopy one, we can continue to use this type of book.

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