TABLET-AIDED LECTURING EFFECTIVENESS: CASE OF THE AUSTRALIAN COLLEGE OF KUWAIT

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ABSTRACT

Being frightened from becoming technologically outdated, higher educational institutions are nowadays competing to deploy the most advanced technologies in their teaching activities. With the exponential growth of technology, this becomes more challenging and resource-demanding; hence, the selection of a sustainable and effective technological solution that best supports the teaching, learning, sociological and pedagogical aspects within the institution becomes crucial. This paper investigates the effectiveness of tablet technology for in-class material delivery from the perspective of the students as well as two other learning tools that are provided by this technology which are: digital in-class written notes and video-recorded sessions. The study is conducted at the Australian College of Kuwait and involves three faculty members, four courses, and a total of 100 students from the Electrical Engineering department. The tablet device is a 2-in-1 stylus-enabled reversible laptop that can be used by the instructors for teaching, research, and other related activities. A quantitative methodology through the use of a questionnaire is then used to evaluate the intention to use, satisfaction, and effectiveness factors for each of the teaching and learning tools provided by tablets. The questionnaire results are finally analyzed through SPSS 25.0 software to draw a conclusion on each of these factors and their relationship with each of the analyzed teaching and learning tools.

KEYWORDS

Tablet, E-Learning, Student Satisfaction, Effectiveness, Standards 8, 9, 10

INTRODUCTION

With the dynamic technology evolution in the 21st century, various technologies have been studied by educational institutions to facilitate the teaching and learning experience for both students and faculty members. As a result, a blended learning environment that combines face to face learning, e-learning and/or online learning has massively emerged. For instance, among other computer-based software, mobile applications are nowadays designed to convert textbooks into interactive material in the form of videos and digital online learning material to benefit the students in case of an online learning environment or to create interactive exercises and problems that assist the students and the instructors in class in case of a blended teaching environment (Kadry et al., 2017), (Prasad et al., 2018). Specific online tools to address hands-on based aspects in engineering education were also suggested and evaluated in the context of distance learning (Krichene et al., 2017). Other digital tools such as the Learning

Management Systems (LMS) and their various features were used to create prediction variables that help in evaluating and predicting students' performance (Conijn el al., 2017). Other studies focused on the barriers confronting the implementation of new technologies in teaching and learning from the perspectives of the teachers (Opeyemi el al., 2019) and recommended adopting changes to the curricula to support digital literacy and promoting digital literacy training for the teachers. Nevertheless, the majority of these studies focused on implementing the new technology without evaluating it quantitatively or qualitatively and without comparing it with alternative solutions that may produce similar outcomes.

Focusing on tablet technology, Hecht et al. (2018) studied the impact of using tablets in a Project-Based Learning (PBL) environment over one semester on engineering courses. The study focused on identifying the required knowledge and skills, defining the problem/project, identifying project criteria, developing knowledge, testing, and evaluating the solutions and refining designs. Although analysis and reflection on the effect of using tablet technology were presented, the study lacked any comparison with results in case tablets were not used. Furthermore, the study was limited to PBL courses and thus restricted the results into this context.

In this paper, in alignment with CDIO standard 10 and particularly the need of faculty members to teach and assess in new ways, the usage of tablets by instructors in a face-to-face traditional learning environment to support teaching and learning in the form of various e-learning tools and resources and create a blended learning environment is suggested. The study is conducted at the Australian College of Kuwait and involved three faculty members, four courses, and a total of 100 students from the Electrical Engineering department. The tablet device is a 2-in-1 stylus-enabled reversible laptop that can be used by the instructors for teaching, research, and other related activities. In class, the instructor uses solely the tablet, its stylus, and other supporting software to deliver the class digitally. This includes writing all in-class notes digitally, playing videos, interacting, or sharing other supporting material with the students. While the instructor explains the lesson, the students visualize a duplicate display of the instructor's tablet's screen via an overhead projector. Simultaneously, the tablet's display, along with the voice of the instructor are video-recorded then shared with the students as supporting online material on the course homepage in the learning management system. Similarly, all in-class notes written digitally by the instructor (e.g., illustrations, diagrams, solutions, etc.) are also saved and shared as documents with the students.

As per CDIO standard 8, focusing on active learning and particularly, on the importance of collecting feedback from students about what they are learning, the effectiveness of implementing tablet technology and various e-learning resources/tools it provides is then evaluated quantitively from the perspective of the involved students in the form of a questionnaire that is based on DeLone and McLane user satisfaction model which was developed in 1992 and revised in 2003 (DeLone et al., 2003) and other similar models and studies (Davis et al., 1989), (Piccoli et al., 2001), (Aldaihani et al., 2018). The results are then analyzed, and a conclusion is drawn.

STUDY DESCRIPTION

The courses involved in this study are four compulsory courses from the Diploma of Electrical and Electronics Engineering program offered at the Electrical Engineering Department at the School of Engineering at the Australian College of Kuwait (ACK) that are delivered by three

instructors from the same department. The courses involved in this study are listed in Table 3 below along with the number of students enrolled in each.

Table 3. Courses Involved in the Study

Course Code	Course Title	Semester	Enrolled Students
15FELE120	Electrical Circuit Analysis II	2	27
15FELE123	Introduction to Computer Programming	2	32
15FELE210	Semiconductor Devices and Circuits	3	23
15FELE212	Digital Logic	3	19

An HP EliteBook X360 2-in-1 G4 laptop, hereafter referred to as "tablet", was used by each of the three instructors engaged in this study. This laptop has the advantage of being used as a normal laptop or converted to a tablet if needed. It is a highly performant tablet that can potentially replace the offices' computers of faculty members. The device pictures are shown in Figure 1, and a summary of its main specifications are listed in Table 4. This tablet was selected after thorough research in order to facilitate e-learning in three forms: e-Class, e-Lecture, and e-Note. It has a relatively low weight and small screen size for the sake of ease of mobility between instructors' offices and classes. It is equipped with a bundled rechargeable stylus, which eliminates any incompatibility issue with separately purchased active pens and battery replacements. It has a built-in full HDMI interface to enable the simple use of the in-class HDMI cable. It is fully compatible with the IT hardware, software, and network infrastructure at ACK.

(a) Laptop Mode (b) Tablet Mode

Figure 3. HP Elitebook X360 2-in-1 G4: Laptop Modes

Table 4. HP EliteBook x360 2-in-1 G4: Notebook Specification

Operating system	Windows 10 Pro 64
Processor Name	Intel® Core™ i7-8565U (1.8 GHz base frequency, up to 4.6 GHz with Intel® Turbo Boost Technology, 8 MB cache, 4 cores)
Memory	16GB DDR4 2666 RAM
Hard drive	512GB PCIe® NVMe™ SSD
Display	(13.3) diagonal FHD IPS anti-glare WLED-backlit
Graphics	Intel® UHD Graphics 620
Wireless	Intel® AX200 Wi-Fi 6 (2x2) and Bluetooth® 5 Combo, vPro™
Stylus	HP Active Pen
Weight	Starting at 1.27 kg

METHODOLOGY

The study is conducted during the Fall 2019 semester, which consists of 17 weeks, 13 weeks of which were teaching, and four weeks were dedicated to midterm/final exams. All involved courses are delivered in class as 3 hours of lectures and 2 hours lab per week. During the first 5 weeks of study, the instructors used the traditional delivery method using ink-based whiteboards. Tablets were used by the instructors afterward until the end of the semester to allow the same sample of students/instructors to be involved for the sake of comparing the two methods of delivery. All lectures are presented in class using an overhead projector that is directly connected to the in-class laptop in case of the traditional delivery method (i.e., during the first 5 weeks) or directly to the tablet via HDMI cable during the remaining of the course. The study presented in this paper investigates the efficiency of three e-learning features/resources provided by the tablet technology: “e-Class”; “e-Lecture,”; and “e-Note.”

e-Class

“e-Class” denotes a face-to-face class during which the instructor uses the tablet as the main electronic tool to conduct the class. For instance, all notes, illustrations, graphs, detailed explanations, exercises, solutions, etc. are written/drawn on the tablet screen using its stylus and various Microsoft software such as Microsoft OneNote, Microsoft PowerPoint, and Microsoft Whiteboard, while the tablet’s display is projected to the students on a large screen. Figure *4* shows an example of using Microsoft OneNote to write a solution for an exercise and draw a diagram.

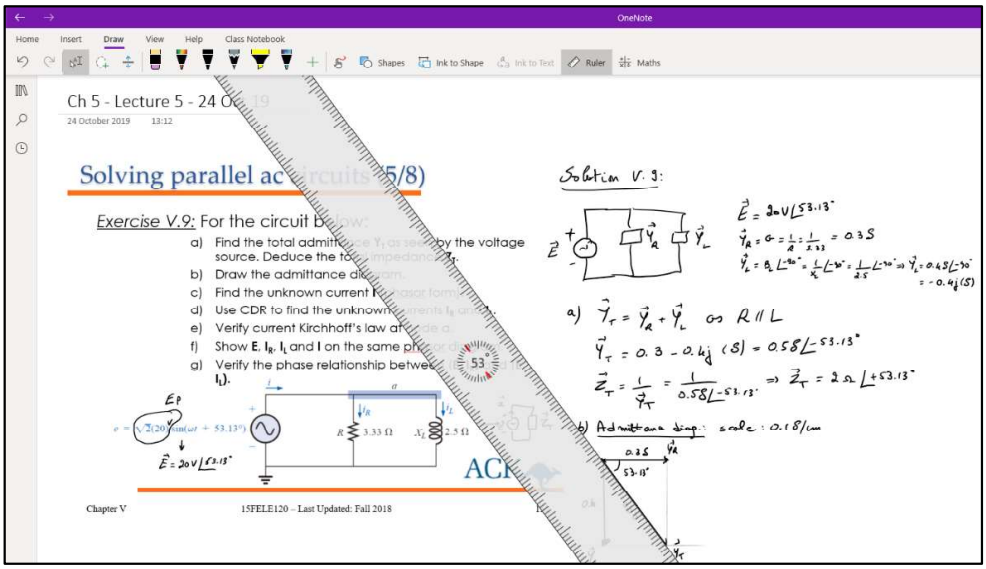

Figure 4. e-Class: Tablet based class delivery using Microsoft OneNote

e-Lecture

"e-Lecture" denotes a video recorded version of a lecture that is shared with the students electronically. Indeed, during an e-Class, the tablet's display and the audio it is capturing are recorded using "Open Broadcast Software" (OBS) freeware software, which is very simple to use and offers the possibility to pause recordings and many other features. The output provided by this software is a video record of everything displayed to the students and the

discussions that occurred in class. This video is then shared with the students using either access-restricted YouTube channels, Dropbox or Google Drive.

Figure 3 shows the "YouTube studio," (i.e., the environment facilitated by YouTube website to upload videos) of one of the instructors with sample videos of recorded lectures for the course 15FELE120 along with the views count of each. Also, Figure 4 shows Google drive Instructor interface used to share videos with students for the course 15FELE210. Simple trimming/merging of video files may also be applied prior to uploading the videos if needed using the simple "Photos" application that is available in Windows 10 operating systems.

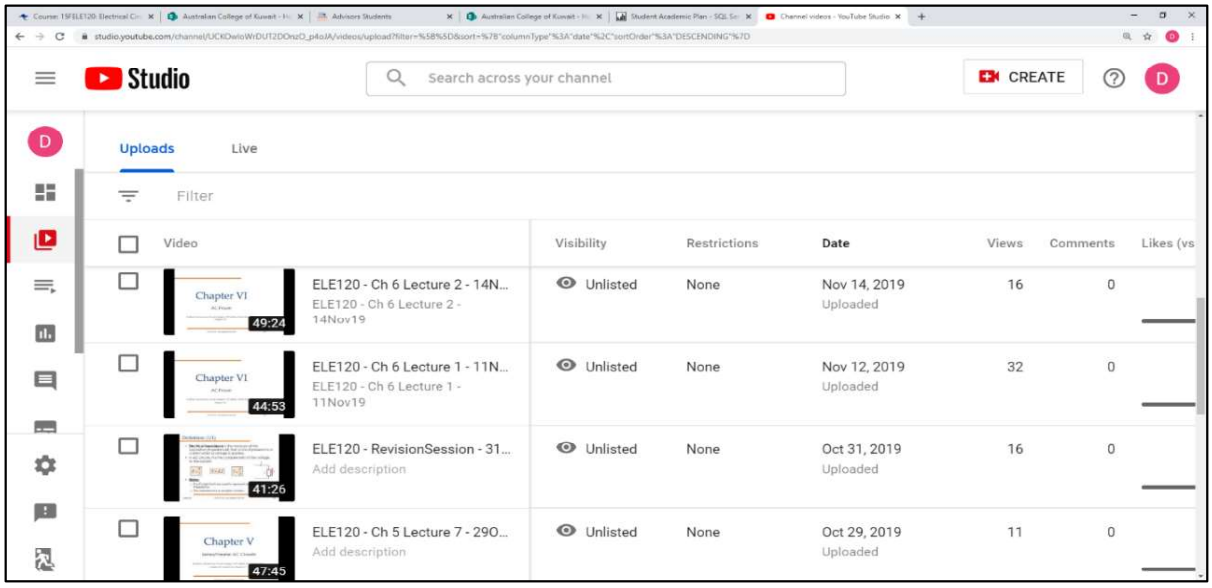

Figure 5. e-Lectures: YouTube Channel of an Instructor (Course: 15FELE120)

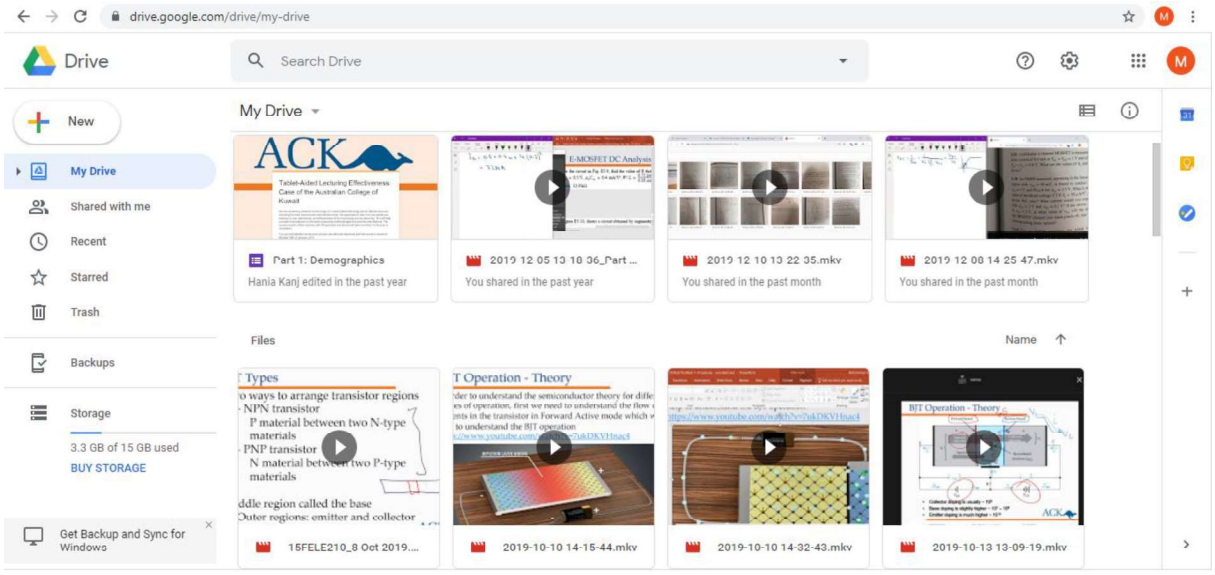

Figure 6. e-Lectures in Google Drive instructor's account (Course: 15FELE210)

As illustrated in Figure 5, whatever the video-sharing platform is, the link to reach the video is shared with the students electronically via each course homepage on ACK's Learning Management System (LMS) and is accessible by the enrolled students only.

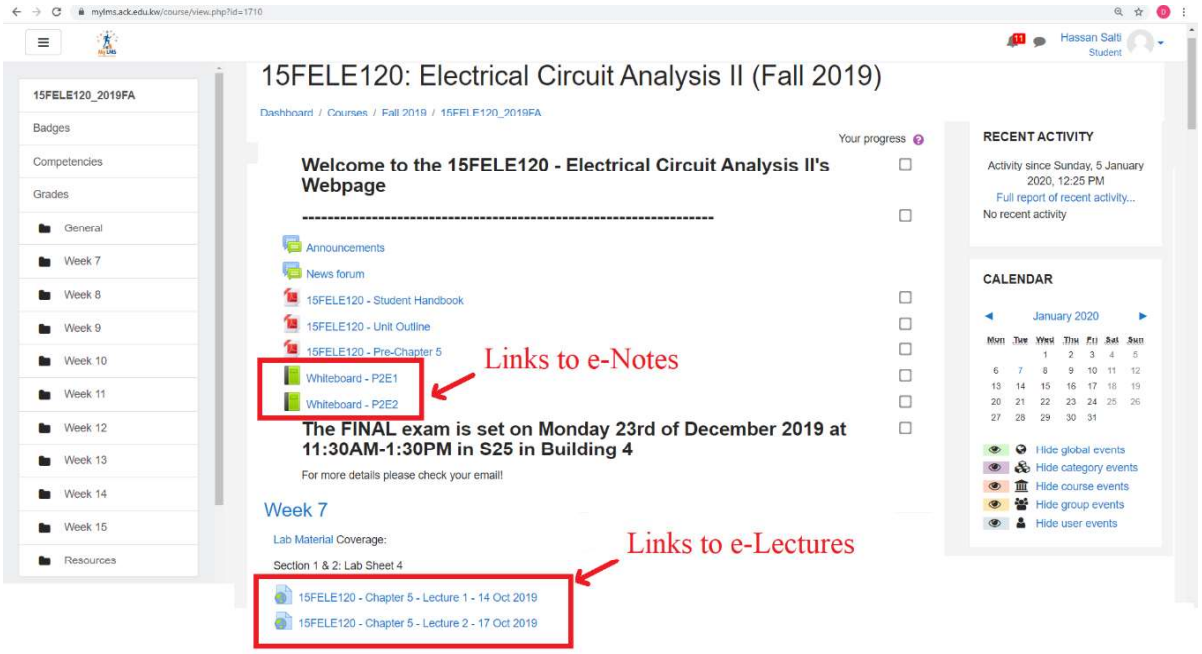

Figure 7. Sharing e-Lectures Links on the LMS (Course: 15FELE120)

e-Note

"e-Note" denotes the soft copy of all the notes written by the instructor during an e-Class and shared electronically with the students. Indeed, whether the instructor is using Microsoft OneNote or Microsoft Whiteboard to write his/her in-class notes on the tablet screen, these notes are saved as an "OneNote" file or a simple "jpeg" image and shared with the students on the course home page on the LMS.

Figure 7 shows a snapshot of the links created to access e-Notes on the course home page on the LMS that are uploaded in the form of an e-portfolio, and
Figure 8 shows a sample part of an e-Note.

STUDENTS' SURVEY

In order to evaluate the overall students' satisfaction, their intention to use the e-learning features/resources provided by the tablet, and accordingly comment on the effectiveness of this technology in the four candidate courses, a pragmatic approach is used through the implementation of quantitative methods.

Instrument Definition

The instrument used is a student survey questionnaire consisting of 69 questions. The questionnaire included two main parts. The first part is dedicated to collect demographic data such as age, gender, nationality, GPA, and semester level of the survey respondents. The

second part consisted of three sections. Each section involved questions related to the three constructs of the conceptual model: (1) Intention To Use, (2) Satisfaction, and (3) Effectiveness. Moreover, each construct has been studied across three factors: (1) e-Class, (2) e-Lecture, and (3) e-Note, which were explained earlier. Table 5 lists all the variables, factors, the subscale variables, and the corresponding codes that are addressed in this case study.

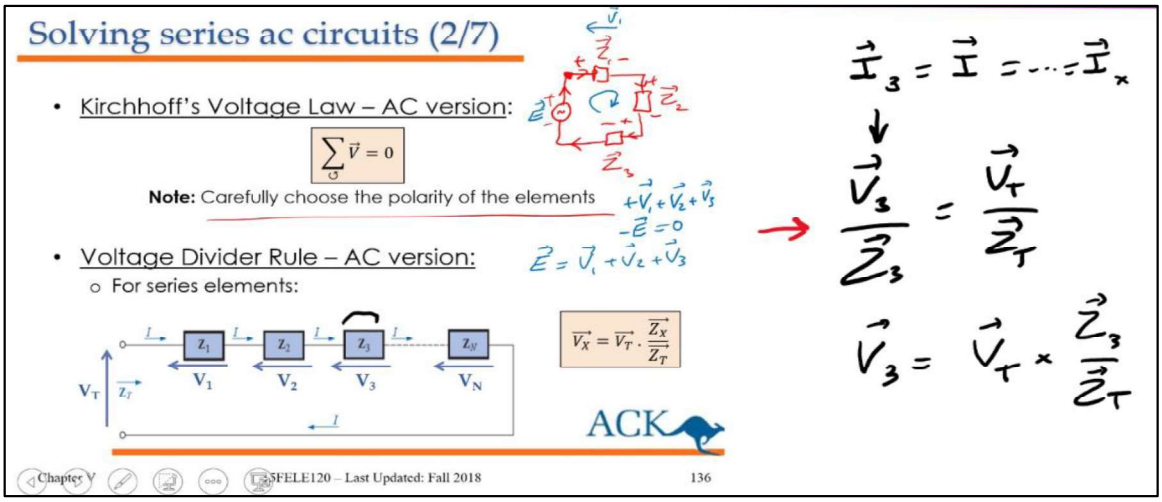

Figure 8. e-Notes: An example

Table 5. Summary of Variables and Sub-Scale Variables

Variable	*Factor*	*Sub-scale Variable*	*Code*
Intention	e-Class	**S**tudent **I**ntention to attend e-**C**lasses	SIC
	e-Lecture	**S**tudent **I**ntention to use e-**L**ectures	SIL
	e-Note	**S**tudent **I**ntention to use e-**N**otes	SIN
Satisfaction	e-Class	**S**tudent **S**atisfaction with e-**C**lasses	SSC
	e-Lecture	**S**tudent **S**atisfaction with e-**L**ectures	SSL
	e-Note	**S**tudent **S**atisfaction with e-**N**otes	SSN
Effectiveness	e-Class	**E**ffectiveness of e-**C**lasses	EC
	e-Lecture	**E**ffectiveness of e-**L**ectures	EL
	e-Note	**E**ffectiveness of e-**N**otes	EN

For each factor, five to eight questions were allocated in the questionnaire, and negative questions were added to flag responses that are filled without carefully reading the corresponding questions and eliminate them accordingly. These measures were taken to ensure higher reliability and validity of the results. All questions were based on five points Likert scale where 1 denotes "Strongly Disagree," 2 denotes "Disagree," 3 denotes "Neutral," 4 denotes "Agree," and 5 denotes "Strongly Agree." As all respondents are diploma level students, the questions were carefully structured to make sure it is clear and understandable by the students. Moreover, a pilot test for the questionnaire was conducted on eight students to collect feedback about the clarity of the questions and adequacy of their level. The feedback was then addressed in the survey questionnaire. The questionnaire was anonymously implemented online using the ACK MyLMS tools and was posted on the course homepage of each of the four candidate courses.

Data Collection

The survey is launched, and data is collected during weeks 15 and 16 (the last two teaching weeks of the Fall 2019 semester), and the data is analyzed afterward using IBM SPSS 25.0 software. Incomplete responses were excluded from the survey due to missing data. As a result, out of the 101 students registered in the four courses, 80 students participated in the questionnaire, which gives an approximate response rate of 79%.

The demographics analysis of the results shows that from the respondents, 53.8% aged between 20-22, 66.3% are males, 83.8% are Kuwaitis, 62.5% have a Grade Point Average (GPA) less than 2.6, and 51.2% are studying in Semester 3. Table 6 illustrates the respondents' demographics.

Table 6. Respondents Demographics

Demographic Item	Category	Frequency	Percentage
Age	Less than 19	16	20.0%
	20-22	43	53.8%
	23-25	9	11.3%
	More than 25	12	15.0%
Gender	Male	53	66.3%
	Female	27	33.8%
Nationality	Kuwaiti	67	83.8%
	Non-Kuwaiti	13	16.3%
GPA	Less than 2.6	50	62.5%
	2.6-3.0	12	15.0%
	3.1-3.5	3	3.8%
	More than 3.5	15	18.8%
Semester Level	Semester 1	1	1.3%
	Semester 2	33	41.3%
	Semester 3	41	51.2%
	Semester 4	5	6.3%

DESCRIPTIVE RESULTS

Descriptive statistics that are used to describe the Intention To Use, Satisfaction, and Effectiveness of e-Classes, e-Lectures and e-Notes are displayed in Table 7 in the form of the mean, median, mode, standard deviation, and variance of each sub-scale variable previously defined in Table 5. These values are obtained after inverting the results of all negative response questions and eliminating invalid responses using SPSS software.

Table 7. Descriptive Results

	SIC	***SIL***	***SIN***	***SSC***	***SSL***	***SSN***	***EC***	***EL***	***EN***
Mean	4.238	4.350	4.444	4.438	4.413	4.500	4.3500	4.413	4.444
Median	4.00	4.00	5.00	5.00	5.00	5.00	4.00	5.00	5.00
Mode	4.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Std. Deviation	.716	.731	.70479	.726	.774	.70711	.731	.741	.61570
Variance	.513	.534	.497	.528	.600	.500	.534	.549	.379

At the questions' level, the results could also be analyzed to extract useful information. For instance, some questions in the students' questionnaire were designed to demonstrate the students' satisfaction with this teaching methodology compared to the traditional way of teaching, a sample question with the corresponding students' responses are shown in Figure 7. Indeed, students' responses to this particular question prove that students preferred the new teaching methodology compared to the traditional one. Similarly, other questions addressed the effectiveness of this methodology in terms of students' understanding from the perspective of the students themselves (c.f. Figure 8).

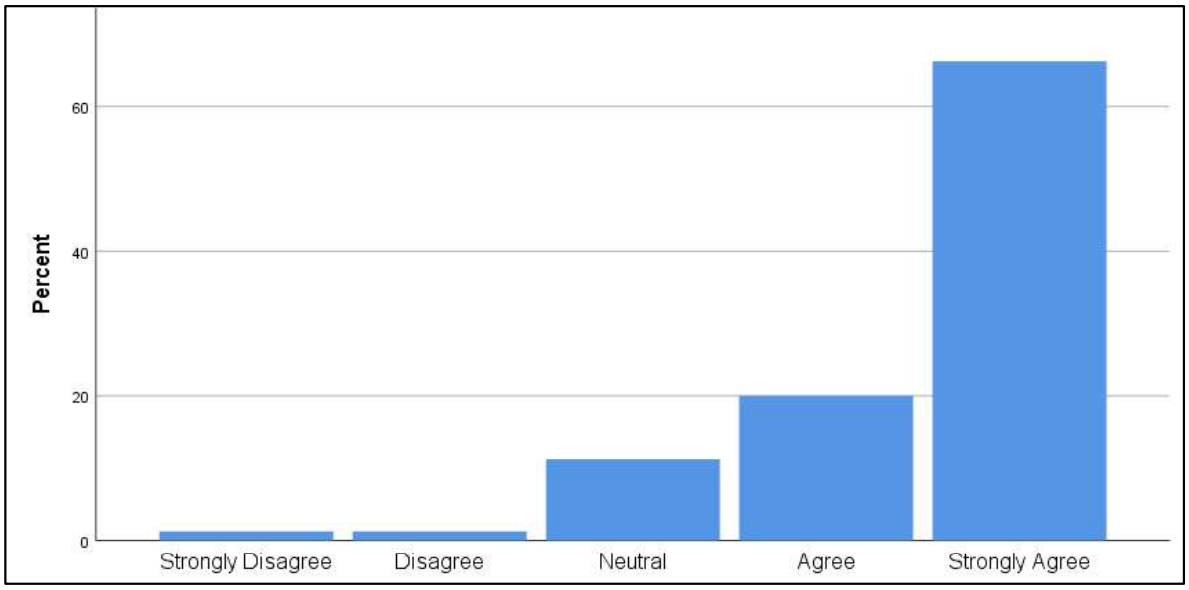

Figure 9. Statistics of question SST4, "I wish other instructors use in-class tablet technology in the units they teach."

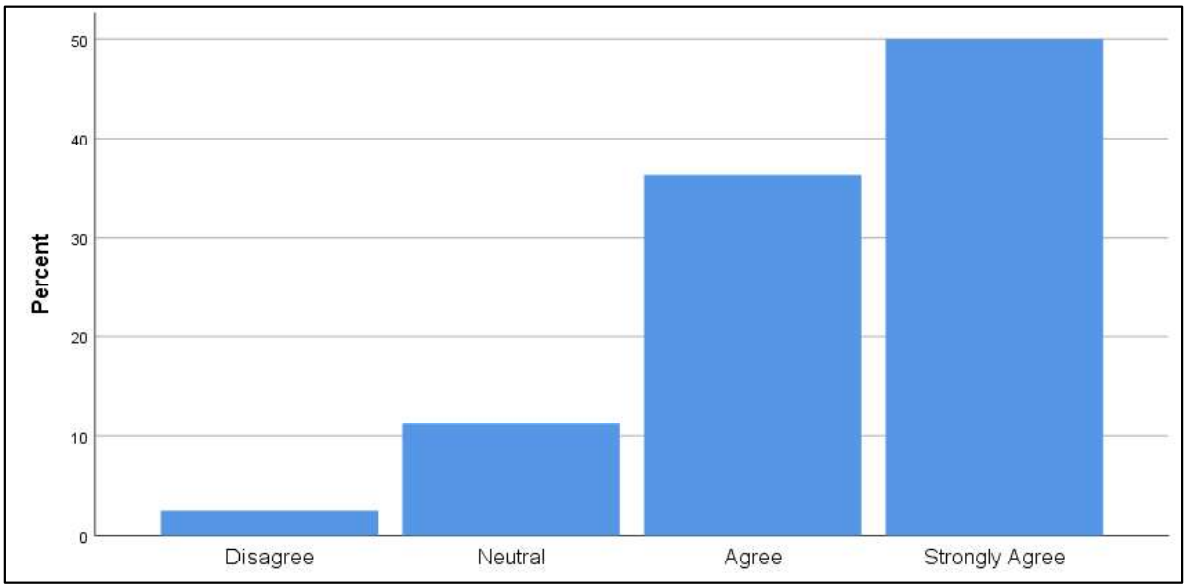

Figure 10. Statistics of question SET5, "The usage of in-class tablet technology by my instructor, improved my understanding of the unit."

DISCUSSION

The results show that the means of all factors are above 4.00 which indicates that the majority of the students responded to the questions with an average of "Agree" to "Strongly Agree." Moreover, the distribution of the responses over the Likert Scale for all sub-variables is positively skewed towards "Strongly Agree." This indicates a high overall intention, satisfaction, and effectiveness for the three e-learning features/resources facilitated by tablets (i.e., e-Class, e-Lecture, and e-Note). The highest mean values were scored by the "e-Lecture" followed by "e-Note" and then "e-Class," which implicitly indicates that e-Lecture is the most effective e-learning resource for the students followed by the e-notes then the e-Class.

CONCLUSION

This paper investigated the effectiveness of using tablets to conduct digitally face-to-face classes and two of the immediate online resources this technology facilitates, which are: shared soft copy of in-class instructor written notes and shared video recorded lectures. This was achieved via a survey questionnaire that is based on previously well-established models to evaluate the intention to use and user satisfaction and comment on the overall effectiveness of this technology. The results show that the use of this technology in class and to provide additional online resources is highly accepted by the students who prove its effectiveness. Future studies will focus on extending the study to cover more courses from various engineering disciplines. Moreover, the correlation between this study results and students' grades after and before technology adaptation will be investigated to support the effectiveness of such a methodology. Furthermore, investigating the intention to use, satisfaction, and effectiveness of the tablet usage from the perspective of faculty members can be explored as well to validate the usefulness of such technology from all stakeholders' points of view.

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BIOGRAPHICAL INFORMATION

Mohamad Zaki *is* a Senior Instructor of Industrial Experience at the Electrical Engineering Department at the School of Engineering of the Australian College of Kuwait. During his work in the field, Zaki gained great experience in the field of Information Technology. He is a certified engineering consultant by many vendors like Cisco, HP, EMC, Microsoft, Citrix, and VMware. Zaki is a member of many International organizations like IEEE and many committees as the curriculum committee. His latest research interest is oriented toward education technology, robotics, and IoT.

Hania El-Kanj *is* an Instructor at the Electrical Engineering Department at the School of Engineering of the Australian College of Kuwait. Her research interests include renewable energy, Bluetooth development kits, and learning management systems. Her recent research is focused on blended learning environments and e-learning in higher educational institutions.

Hassan Salti is an Assistant Professor and the Head of the Electrical Engineering Department at the School of Engineering of the Australian College of Kuwait. In addition to his technical engineering research interests, he is currently involved in the restructuring of engineering curricula as well as internal and external audits and accreditations such as Engineers Australia and ABET. He is also a member of the CDIO committee and working group at the Australian College of Kuwait.

Mohammed Abdul-Niby received a B.Sc. in electrical engineering and M.Sc. in Electronics and communications degrees from the College of Engineering, University of Basrah, Iraq, and the Ph.D. degree from the University of Surrey, the United Kingdom in 1998. He is currently an Assistant Professor and the Dean-School of Engineering at the Australian College of Kuwait. He has published in areas of signal processing, microelectronics, and electronic circuits. His current research interest includes simulation modeling of semiconductor devices, characterization of implanted silicon, and renewable energies. He is also currently involved in the restructuring of engineering curricula, internal and external audits such as Engineers Australia and ABET, and is a member of the CDIO committee at the Australian College of Kuwait.

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