E-LEARNING DURING COVID-19 EPIDEMIC: EXPERIENCE OF A UNIVERSITY FROM JORDAN

Fadi R. Shahroury, Princess Sumaya University for Technology

ABSTRACT

Electronic learning (e-learning) has gained the interest of both academics and practitioners for many years and has been widely applied in many countries. Various educational bodies have made several attempts at e-learning. However, these attempts remain as a supplement to traditional face-to-face learning. The COVID-19 has had an extensive impact on the global higher education sector. Initial responses in many countries were focused on the delivery of online lectures to students who were unable to attend their normal lectures and laboratories due to different strategies of social distancing, quarantine, and lockdown. Faculties rushed to convert curriculum to online material, deliver online lectures and figure out appropriate assessment tools, mindful of the existing infrastructure and the uncertainty surrounding this epidemic. This article analyses the application of e-learning in the engineering faculty at Princess Sumaya University for Technology (PSUT) in Jordan. It is one of the first studies to explore the application of e-learning in electronics engineering courses during the COVID-19 epidemic in a developing country context. The results demonstrate that the use of the flipped classroom strategy helped to overcome the challenges associated with e-learning of the Electronics II course and maintain an overall performance that is consistent with previous performance results. A number of theoretical and managerial implications for higher education institutions were also identified.

Keywords: E-learning, Distance Learning, E-engineering, COVID-19

INTRODUCTION

The outbreak of COVID-19 at the end of 2019 was a major health emergency. This virus had the fastest spread, the widest scope of infection, and the most difficult to control (Zhou et al., 2020). According to UNESCO, more than 100 countries were affected by the first wave of COVID-19 between March 23 to June 1, 2020 (Global Education Coalition, no date; Huang et al., 2020). COVID-19 had dramatic impacts on all aspects of everyday life, including education. Countries' first responses encouraged hygiene and social distancing; however, as the virus continued to spread massively and the number of confirmed cases drastically increased, countries moved towards stricter and more stringent strategies such as quarantine and complete lockdown.

These strict strategies led to the stop crowd gatherings. They suspended the production and business operations of non-essential enterprises, including the complete shutdown of all educational institutions such as schools, universities, and all higher education bodies due to the high number of students, which creates an appropriate atmosphere for spreading the virus. Like many countries, Jordan is one of the developing countries which has been dramatically affected by COVID-19. Jordan has 345 confirmed cases as of April 6 (Organization and others, 2020). In an attempt to prevent the spread of COVID-19, Jordan closed all its borders on March 17 and made extreme regulations such as imposing lockdown (Safi, 2020), closing schools and universities, and moving the teaching process to online platforms. This sudden transition to e-learning can be considered a test of universities' agility, where some have focused on delivering

Citation Information: Shahroury, F.R. (2022). E-Learning during covid-19 epidemic: Experience of a university from Jordan *Academy of Strategic Management Journal, 21*(S4), 1-14.

online lectures but not necessarily following an online pedagogy. Further, this transition has raised several questions about the readiness of universities for e-learning and the impact of poor infrastructure and limited access to the technology of socially disadvantaged learners on the success of e-learning and the ability of students to fully engage in such online educational environment.

Table 1
OPEN SOURCE EDUCATIONAL PLATFORMS

Platform	Main Use	Tools	Accessibility	Peculiarity	Users	Languages
Atutor	Course creation	Forums Surveys Calendar Personal messages	Main web browsers	ZIP format allowed	1 Administrator 1 Instructor per course Students	32 languages
Chamilo	Document management and collaboration	Learning methodologies 20 educational tools	Linux, Windows and OS-X Connection with other apps	Easy use and group creation	In school and business	58 languages
Canvas	Courses base on announcements debates and grades	Communication system Calendar Activity tracker	Web browsers Mobile devices	Complete work on the cloud	Account level Course level	33 languages
Com8s	Organization, sharing and storing contents	Virtual Schedule Videoconferences Forums	With Adobe Flash Player pluging	Personal or shared working area	In school and business	Spanish English Portuguese
CoffeSoft	Collaborative activities creation in learning communities	Mental maps design Document sharing Notes Charts	In the Internet	Lessons formed by sessions	Educational institutions	Spanish
Didactalia	Personal learning and real time information	Interactive maps Science games Course edition and creation	Web browsers Mobile devices	Predictive evaluation	X	Multilingual
Dokeos	Course creation management and collaboration	Intuitive and friendly tools	Mobile devices	Easy modular adaptation	Manager Course level (several, administrator, user)	Over 30 languages
EDU 2.0	Virtual learning environment creation and interaction	Collaboration Communication Multimedia files	Web browser Mobile devices	Family can track students' activities	Free for 2,000 students	10 languages with automatic translation

Citation Information: Shahroury, F.R. (2022). E-Learning during covid-19 epidemic: Experience of a university from Jordan *Academy of Strategic Management Journal, 21*(S4), 1-14.

		Evaluation				
		Personal library				
Grouply	Online working group and social networking	File updating	In the Internet	Public or private network groups	X	Spanish
		Communication blackboards				Catalan
		Blogs				Galician
		Discussion groups				
.LRN	Communication, evaluation and management system	Forums	*Via* OpenACS web application framework	Interaction with external apps	§ Administrator	7 languages
		Virtual collaboration			Teachers	
		Alert calendar			Students	
Moodle	Creation and management of learning environments	Collaborative tools		Courses massively creation and backed up	Privileges and access levels	Over 120 languages
		Calendar	Web browser			
		Cloud file uploading	Mobile devices			
		Multimedia editor				
		Tracking tools				
Sakai	Collaboration and leaning environment for higher education	Teaching-learning tools	Java language	Open code in 2 packages:	Over tan 350 universities	19 languages
		Administrative tools		Education platform	Administrator, course level and users	
		Portfolio tools		Collaborative training		

Table 2
PROPRIETARY EDUCATIONAL PLATFORMS

Platform	Main Use	Tools	Accessibility	Peculiarity	Users	Languages
Almagesto	Management of virtual learning projects with technology and technical support	Virtual classrooms		Virtual campus with several schools and company virtual schools	With campus and school licenses	English
		Exams and self-evaluation	Internet Explorer			Spanish
		Surveys	Firefox			French
		Debate forums	Chrome			Portuguese
		Video library				
Blackboard	Content management, course personalization, evaluation, system integration, collaboration and course access	Digital course repositories	Internet Explorer		Teachers and students integration	15 languages
		Virtual communities	Netscap	Special programs for the blind		
		Multimedia creator	Firefox			
			Mobile devices			
Cloudera	Data management with centralizing functions, analysis processing and	Big Data solution and analysis tools	Open code and open standards	Corporate high level system, training and	Business area	Multilingual

Citation Information: Shahroury, F.R. (2022). E-Learning during covid-19 epidemic: Experience of a university from Jordan *Academy of Strategic Management Journal, 21*(S4), 1-14.

	security			support with license		
QS Media (Kedros)	Management and administration of training courses	E-Learning development environment	Compatible with AICC and ADL SCORM Standards	Scalable	Adaptable to different shorts of users	Multilingual
		Courses and contents implementation				
Schoology	Education and social network	Working groups	Mobile devices	Private and public profiles	From Elementary school up to college	English
		Forums & Evaluation				Spanish
		Document sharing				French
		Audio and video record				Malaysian
						British
WalkMe	Collaborative participation	Notification data collection	On the cloud	User guidance and suggestions	Business area	Multilingual

Historically, teaching in Jordan started by using chalkboards and then advanced to the use of transparencies and overhead projectors. Afterward, PowerPoint emerged as a powerful vehicle that has been extensively used since then to deliver content through slides into classroom screens. Other tools such as e-mail, online submission of homework, smart board, and videoconferencing have also been used to supplement traditional lectures. During the COVID-19 crisis, Jordanian universities were required to offer online materials and give online lectures. Universities use various platforms to live broadcast lectures such as Skype, Google Classroom, Moodle, Zoom, and Facebook. Universities are also required to provide the Ministry of Higher Education and Research with the number of courses converted to online media and the number of students who log on to a university's online learning platforms.

Despite these massive efforts to continue teaching and delivering online lectures and learning materials during this crisis, offering an effective e-learning experience is far from simply converting conventional curriculum content to an electronic format and posting it onto a web-based repository. Successful e-learning involves creating an interactive and dynamic environment that fosters effective students' engagement and practical assessment tools beyond the traditional methods such as the use of dynamic content, discussion boards, virtual quizzes, and simulation tools and finding interactive solutions to maintain rigorous education. The current COVID-19 crisis could be seen as the appropriate climate for the transition to the digitalization of the curriculum and e-learning in Jordan, mindful of the challenges associated with the speed needed for this transition and the technological and infrastructure challenges. This paper will explore the introduction and delivery of an e-learning experience for a third-year undergraduate engineering course in the electrical engineering department in PSUT in the face of the COVID-19 epidemic. Electronics II is a fundamental course for all engineering programs. Typically, the traditional teaching methods for these courses are mainly lectures and labs; however, the outbreak of COVID-19 required the transition into online teaching and assessment methods. Tools such as simulation exercises (Daniels & Shaffer, 1998; Ayasun & Nwankpa, 2005; Qader & Qader, 2016; Hinz & Hasimi, 2018), or lab exercises (George, 2020; Ren & Wu, 2020; Stoliarov, Kiselev & Kuznetsov, 2020), flipped classroom (Erdogmus & Péraire, 2017; Paez, 2017; Karabulut-Ilgu, Jaramillo Cherrez & Jahren, 2018; Lin, 2019; Gren, 2020) and project-based learning (Chu, Lu & Sathiakumar, 2008; Montes, Castro & Riveros, 2009; Karunaratne, 2018; Huang, 2019) could be

Citation Information: Shahroury, F.R. (2022). E-Learning during covid-19 epidemic: Experience of a university from Jordan *Academy of Strategic Management Journal, 21*(S4), 1-14.

used for distance learning. During this crisis, the flipped classroom approach is used that allows better student engagement through online peer-to-peer and peer-to-professor interactions on E-learning (a Moodle-based online learning platform). A list of the most popular open source platforms and their corresponding features are provided in Table 1 and a list of the most popular proprietary platforms are provided in Table 2. Moodle was used because it is an open source platform, one of the most used platform for distance learning, web and mobile compatible and can support many languages.

COURSE OVERVIEW

Electronics II is a third-year, second-semester course in the Department of Electrical Engineering at PSUT, Jordan, introducing operational amplifiers: basic theory, characteristics, and applications. BJT and MOSFET current mirrors. Differential and multistage amplifiers. The frequency response of single and multistage BJT and CMOS amplifiers. Negative feedback analysis: feedback topology, properties, and stability analysis. Along with operational amplifier design and simulations project.

The course comprises three contact hours per week, traditionally delivered in face-to-face lectures using a chalk-and-talk style. The course is assessed through:

- First Exam – 20%
- Second Exam – 20%
- Assignments – 10%
- Individual Project – 10%
- Final Exam– 40%

The grading system for this course is a Percent grade where 50/100 is the pass mark.

Learning Outcomes

The learning outcomes of the course are that upon successful completion of the course, students should be able to:

LO1 for the operational amplifier (Op-Amp):

- Describe the uses, application, and functioning of Op-Amp (as a Black Box).
- Compute the voltage closed-loop gain, input resistance, and bandwidth for various op-amp circuits.
- Demonstrate the ability to analyze and design Op-Amp.

LO2 for the cascode stages and current mirrors:

- Describe the uses, application, and functioning of cascode stages and current mirrors.
- Compute the voltage gain, current gain, input resistance, output resistance.
- Demonstrate the ability to analyze and design cascode stages and current mirrors circuits.

LO3 for the differential amplifiers:

- Describe the uses, application, and functioning of differential amplifiers.
- Compute the differential-mode gain, and common-mode gain, common-mode rejection ratio (CMRR).
- Demonstrate the ability to analyze and design differential pair amplifiers.

LO4 for the frequency response:

- Describe Bode's rules, Miller's theorem, and frequency response of the single-stage amplifier, cascade stage, and differential pair.
- Compute the upper and lower cut-off frequencies, dominate pole, midband gain.
- Demonstrate the ability to analyze and compute the frequency response for stage amplifier, cascade stage, and differential pair.

LO5 for the feedback:

Citation Information: Shahroury, F.R. (2022). E-Learning during covid-19 epidemic: Experience of a university from Jordan *Academy of Strategic Management Journal, 21*(S4), 1-14.

- Describe positive and negative feedback, stability, and compensation.
- Compute the feedback factor, amount of feedback, and gain and phase margin.
- Demonstrate the ability to the analysis of feedback circuits for the four types of feedback and the effect of finite input/output impedance.

Previous Performance

The course is offered in the second semester, the third year of a five-year electrical engineering program. This course is one of the challenging courses in the program, students complain of the difficulty of its topics and tend to delay it where possible. Historically, there are poor pass rates and low exam averages, with approximately 35% of students routinely failing the course.

Feedback from students indicated that a significant number were not effectively engaged with material during the semester and only cramming before each exam. This was reflected in the poor quality of exam papers that contained many basic engineering mistakes and misunderstandings. Many students also admitted that they could not properly manage their time by the end of the semester as assignments and projects started to pile and ended up with a backlog of work that sent them into negative participation of the assignments. The minority of students who effectively engaged in the course and managed their time did perform well in the course properly.

These traditional challenges of the course pose additional pressures on the e-learning transition during the COVID-19 epidemic. The course administrators searched for a learning strategy to ensure students' engagement and involvement in the course material without chalk-and-talk lectures through the flipped classroom.

THE FLIPPED CLASSROOM

Flipping the classroom is a way of generating an interactive and flexible learning atmosphere where students can review course material as delivered by the lecturer many times as needed and highly absorb and engage in the course material. According to Lin (Lin, 2019), the flipped classroom technique can improve students' achievement, attitude, and learning motivation. Moreover, Gren (2020) claimed that introducing flipped classrooms to software engineering courses can improve students' academic success. In this study, the flipped classroom was applied based on video-recorded lectures broadcast on the E-Learning platform and the discussion group on Zoom. The lecture and discussion group are offered at the exact time of the original lecture, and attendance is recorded to ensure that students engage in each lecture and not pile all the lectures to the end of the semester. The first and second exams were changed to a series of weekly online assignments where students are required to record a short video solving one of the assignment questions and traditional paper submission of all assignment questions. The assignments which traditionally weigh 10% remain the same. As for the individual project was changed to a video-recorded lecture delivered by each student, where students were randomly assigned one of the topics of the course material. The final exam was also conducted online.

Citation Information: Shahroury, F.R. (2022). E-Learning during covid-19 epidemic: Experience of a university from Jordan *Academy of Strategic Management Journal, 21*(S4), 1-14.

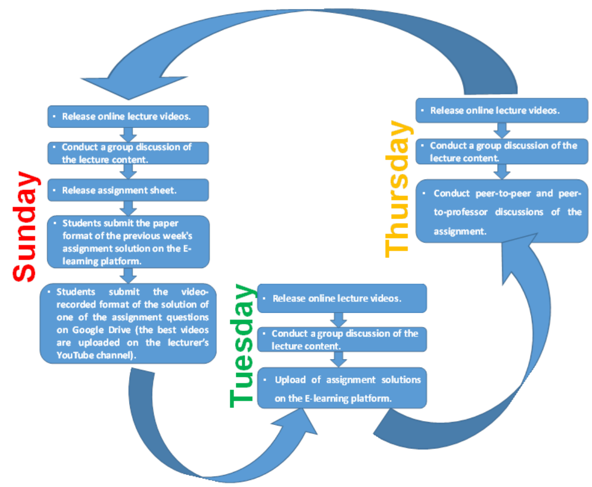

FIGURE 1
WEEKLY CLASS STRUCTURE

The e-learning transition started after a month from the start of the semester; operational amplifier and single-stage were covered by the traditional lectures, which count for 20% of the course material. The other topics of the current mirror, differential pair, high-frequency response, and negative feedback, were to be delivered entirely online. Each week which runs from Sunday to Thursday, was structured as follows and illustrated in Figure 1:

Sunday:

- Release online lecture videos.
- Conduct a group discussion of the lecture content.
- Release assignment sheet.
- Students submit the paper format of the previous week's assignment solution on the E-learning platform.
- Students submit the video-recorded format of the solution of one of the assignment questions on Google Drive (the best videos are uploaded on the lecturer’s YouTube channel).

Tuesday:

- Release online lecture videos.
- Conduct a group discussion of the lecture content.
- Upload of assignment solutions on the E-learning platform.

Thursday:

- Release online lecture videos.
- Conduct a group discussion of the lecture content.
- Conduct peer-to-peer and peer-to-professor discussions of the assignment.

Citation Information: Shahroury, F.R. (2022). E-Learning during covid-19 epidemic: Experience of a university from Jordan *Academy of Strategic Management Journal, 21*(S4), 1-14.

Assessment

The traditional written first and second exam was replaced with comprehensive weekly assignments, including both descriptive and calculation questions. Students are given one week to solve the assignment and are required to submit the solution of all questions in electronic or handwritten, then scanned format and uploaded to the E-Learning. Additionally, students are also required to record a short video explaining and discussing how they solved one of the assignment questions which were randomly assigned to them and then upload it on Google Drive; the best videos were then uploaded to the lecturer's YouTube channel.

Moreover, to overcome the challenge of copying answers, two strategies are used; first, a new grading criterion is used which is based on attempting to answer the questions rather than getting the correct answers for all assignments. Second, ask students to video-record themselves while explaining and answering one of the weekly assignment questions as if they were a lecturer teaching students. Doing so will minimize the occurrence of copying and ensure a higher level of students' understanding and engagement in the course topics. Additionally, students are encouraged to watch each other short videos where peer-to-peer and peer-to-professor discussions are conducted each Thursday for the weekly assignment, allowing students to evaluate each other's videos, including explanation methods, clarity, and ability to deliver the solution to other audiences. Additionally, these discussions are also conducted on the video-recorded lecture that each student and count provide for the individual project in the traditional settings.

Further, it is worth mentioning that the lecturer asked the students to upload their videos on YouTube. Interestingly, 22% of students, mainly females, refused to appear on YouTube (Electronics II class website, no date) and preferred that the lecturer only assesses their videos. This could be attributed to fear of public appearance due to some traditions and norms of the country, which in general poses extra challenges for the e-learning experience in developing countries. For illustration, two questions of one of the assignments are provided next.

Q1. Consider the circuit of Figure 2, Where I_{D5}=200 μA and I_b=100 μA

1. Find the width of M6.
2. Find the common-mode input range.
3. Find the differential-mode gain ($v_o/(v_1-v_2)$).
4. Find the differential-mode gain with a 100KΩ load resistor.

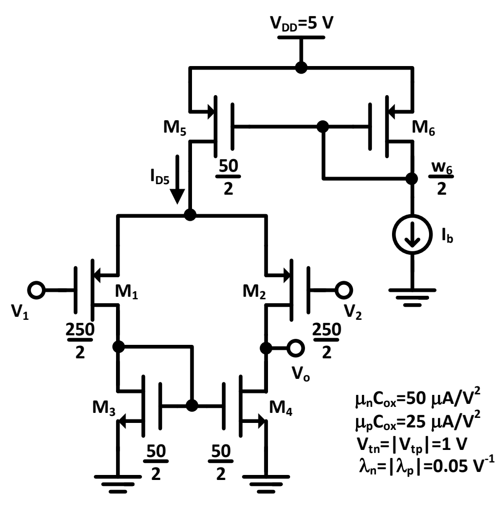

FIGURE 2
SINGLE-ENDED DIFFERENTIAL PAIR

Citation Information: Shahroury, F.R. (2022). E-Learning during covid-19 epidemic: Experience of a university from Jordan *Academy of Strategic Management Journal, 21*(S4), 1-14.

Q2. Consider the circuit of Figure 3, where W/L=40 for all transistors except M11 $v_{tn}=|v_{tp}|= 1V$, $\mu_nC_{ox}=90\mu A/V^2$, and $\mu_pC_{ox}=30\mu A/V^2$.

1. Find overdrive voltage for M1 through M4, and M7 through M10.
2. Find the v_o (max).
3. Find $(W/L)_{11}$ for the lowest v_o.

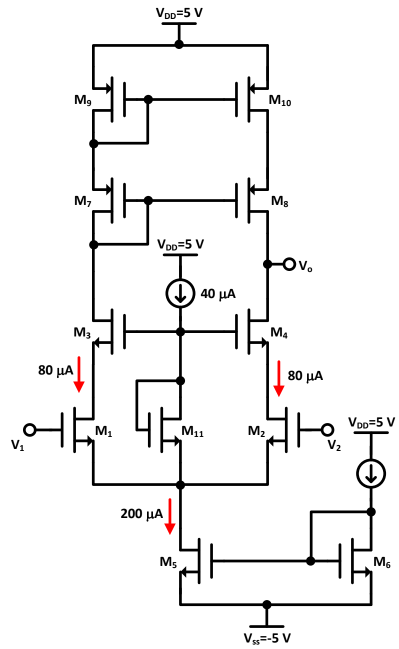

FIGURE 3
CASCODE DIFFERENTIAL AMPLIFIER

RESULTS AND DISCUSSION

The Lecturer's Impressions

The lecturer found that the flipped classroom strategy resulted in a higher degree of students' engagement in the course. Students were actively engaged in each lecture-discussion group, asking questions, building on their peer's work, attempting to answer all assignment questions. The weekly assignments helped students keep on track with the course material; the videos brought a new interesting spirit into a very traditional engineering course. It introduced students into the world of teaching, boosted their confidence and creativity, and developed their communication and presentation skills. It confirmed the lecturer's suspicions that the best way of understanding a topic is actually trying to explain it and teach it to others. Moreover, the peer-to-peer assessment created a positive atmosphere where many students began openly praising their colleagues and discussing their own shortcomings and misunderstandings; they were more comfortable in discussing and elaborating on others' work; they were actually learning from each other. This positive atmosphere, openness, and distance social bridges might be beneficial to break down the negativity, fear, and apprehensions caused by the COVID-19 lockdown.

Students' Impressions

Students' responses to the flipped classroom strategy were mixed but generally positive. Early responses were more of hesitation and fear of the experience or technical issues rather than

Citation Information: Shahroury, F.R. (2022). E-Learning during covid-19 epidemic: Experience of a university from Jordan *Academy of Strategic Management Journal, 21*(S4), 1-14.

negative. These responses are of particular interest in light of the studies by (Jaggars, 2014; Martinez, Aguilar & Ortiz, 2019) who note that students typically prefer to take difficult or fundamental courses *via* traditional face-to-face lectures instead of online ones. Students were rushed into non-traditional course settings for the first time during dramatic global circumstances caused by the outbreak COVID-19. Some of the students' early responses are:

"This is a very difficult course, I doubt that I can understand the lectures this way, I would prefer a face-to-face interaction"

"My internet connection is poor, it takes a lot of time to download the lecture video which exceeds the lecture time and thus I can't take part in the discussion group and if I have questions, I have to leave it to the next lecture"

On the other hand, the majority of students appreciated the flexibility that the flipped classroom strategy brought to the course, as they were able to watch the video-recorded lectures as many times as needed at their own ease. One student comments: "I am very grateful that I can watch the lecture over and over again whenever I need that, it is very useful". Further, many students commented on how the weekly assignments kept them on track with the course and helped them to study the course material lecture by lecture rather than cramming before exams. One student comments: "The weekly assignments were very beneficial for me, it forced me to study the material. To be honest, in the beginning, I felt it is too much workload, but it turned to be extremely helpful". Another student notes: "I found the weekly assignments to be very helpful, it forced me to study and follow up with the lecturer".

Further, the assessment methods of the flipped classroom strategy, especially "playing the lecturer role" in video-recording themselves explain and solving assignment questions, or video-recording a lecture instead of the traditional course project, have also brought mixed responses. Early responses were mainly negative and brought a lot of debate and discussion. Students were reluctant to go through this experience as it was their first time to take the role of a lecturer or being watched and evaluated by their colleagues. Some of the early responses are:

"I am a very shy person, I just can't stand in front of a crowd and do a lecture".

"I just do not like the idea of appearing online or being watched by my classmates nor being evaluated by them".

"How I am supposed to do that, I need a camera and some settings which I don't have!".

"I am sorry, it is not my role to be the lecturer even if it is only for a short video, I just don't want to do so".

However, the lecturer explained to the students that the videos do not necessarily need special settings or devices it could be simply recorded using a mobile phone, and that they have the freedom to use whatever method or tool they prefer, and that the main reason for using this assessment tool is that the best way to evaluate students' understanding of a topic is their ability to explain it and present it. It entails that students will definitely review the lecture material, read the textbook, or even do a little research on the internet before recording the video. Despite the early hesitation, students' responses after submitting their first video were extremely positive. They appreciated how recording the video made them prepare well, revise the lecture material. The majority of students even asked the lecturer to continue using this assessment tool even after returning to normal university life once the COVID-19 crisis ended. Some students comment:

"I just want to thank you very much for coming up with this idea. It is amazing, I really enjoyed being a lecturer even for a once".

Citation Information: Shahroury, F.R. (2022). E-Learning during covid-19 epidemic: Experience of a university from Jordan *Academy of Strategic Management Journal, 21*(S4), 1-14.

"I have to say that I had to go over my notes and watch the lectures again, but I am surprised I actually liked it, I am quite sure now that I fully understand the topic that I presented".

"I don't mind if you decide to go ahead with the video tool thing instead of the final exam, I think it is a very fair assessment tool in such circumstances".

OVERALL PERFORMANCE

The outbreak of COVID-19 and the consequences of lockdown has posed extra challenges on the course administrators to continue the course and to maintain a consistent course performance with the previous semesters especially that the lockdown occurred in week 4 of the semester and there was no previous experience with e-learning or a transition period. To assess the effectiveness of the flipped classroom strategy, we compared the overall course performance of the studied semester (Spring 2019/2020) with the performance of the last two academic years. Figure 4 illustrates the percentage distribution for the last five semesters. Fall 2018/2019 is not included because the number of enrolled students in the course was 10. Table 3 shows the number of enrolled students in the course.

Table 3
NUMBER OF ENROLLED STUDENTS IN ELECTRONICS II

Semester	No. of Student
2017-2018 Fall	98
2017-2018 Spring	40
2018-2019 Spring	37
2019-2020 Fall	30
2019-2020 Spring	68

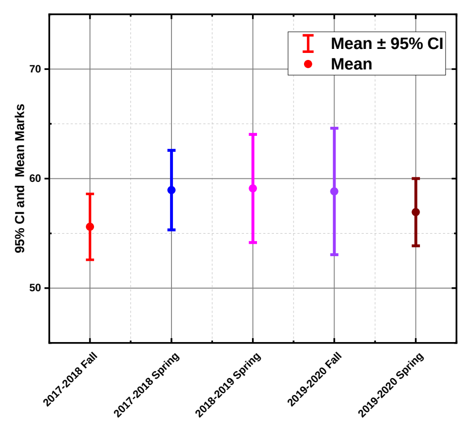

FIGURE 4
95% CI AND MEAN MARKS FOR ELECTRONICS II IN THE LAST FIVE SEMESTERS

The percentage of students in the failing (mark <50) and highest mark (marks between 80-100) categories of the course in the studied semester are consistent with the percentages of the previous semesters. The percentage of students who achieved marks between (50-79) have witnessed a slight change where a shift to the lower category (50-59) occurred to the detriment of

Citation Information: Shahroury, F.R. (2022). E-Learning during covid-19 epidemic: Experience of a university from Jordan *Academy of Strategic Management Journal, 21*(S4), 1-14.

the (70-79) category. Figure 5 shows the average of marks and confidence intervals for Electronics II in the last five semesters. The average marks for the studied semester have slightly changed but remain consistent with the previous semesters.

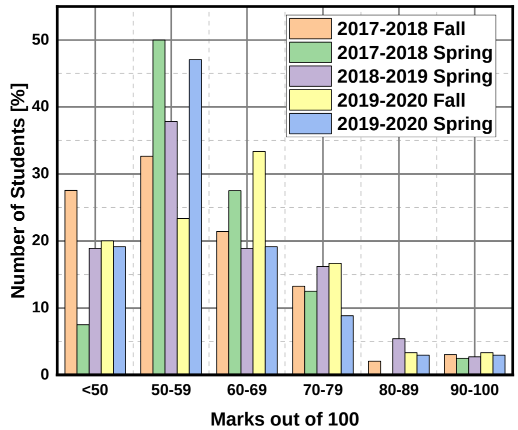

FIGURE 5
THE PERCENTAGE DISTRIBUTION FOR THE LAST FIVE SEMESTERS

The flipped classroom strategy proved to be an effective method of e-learning for the Electronics II course, as the overall performance of the course in the studied semester remained consistent with the performance of the previous semesters and helped overcome the challenges caused by the outbreak COVID-19.

RELEVANCE TO ABET STUDENTS' OUTCOMES

In this course, the instructor is required to assess outcomes (1, 3 and 6). This section explains how these outcomes were met. Regarding outcome 1, "an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics" was met through the assignments described earlier in which the student is required to identify, formulate and solve the problem given in the assignments' questions. Regarding outcome 3, "an ability to communicate effectively with a range of audiences" was met by asking students to video record his solution. He is required to use the appropriate terminologies gained through lectures to communicate with his classmates effectively. Finally, regarding outcome 6, "an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions" was met by asking students to video record a lecture on one of the course topics through which he will be able to add his own judgments and interpretation on the selected topic.

IMPLICATIONS AND CONCLUSION

Managerial Implications

The findings of this study can have important implications for instructors and higher education institutions interested in enhancing their e-learning experience through the use of the flipped classroom. Instructors could consider using this method to improve students' engagement

Citation Information: Shahroury, F.R. (2022). E-Learning during covid-19 epidemic: Experience of a university from Jordan *Academy of Strategic Management Journal, 21*(S4), 1-14.

and enhance the overall e-learning experience. Moreover, higher education institutions could consider introducing various e-learning tools such as flipped classrooms into their traditional courses as a complementary method for creating an interesting and dynamic learning environment.

Theoretical Implications

The findings of this study can have important theoretical implications. For, engagement theory posits that engagement in learning activities is achieved through interaction with others and tasks and that such engagement could be achieved without using technology. Our results demonstrate that as opposed to what engagement theory suggest that technology is a facilitator for students' engagement, we found that technology is the main method for delivering learning materials and engaging students in the learning activities, especially in situations similar to the one that this study was conducted in, where the COVID-19 outbreak forced all universities to shift into e-learning.

Conclusion

This paper analyzed the e-learning experience in a traditional engineering course with poor student performance which is delivered in dramatic circumstances caused by COVID19. The results confirmed that the primary reason for low performance was poor students' engagement and involvement in the course. Introducing an interactive method of teaching and assessment of the course "flipped classroom" led to a higher level of student engagement and performance despite some challenges related to poor infrastructure, students' inability to access necessary software, and fear of public appearance on e-learning platforms due to some traditions and norms which hinder full engagement in the flipped classroom strategy. The results reveal that the flipped classroom is a promising strategy to introduce e-learning pedagogy into traditional engineering courses by enabling a higher level of flexibility in engagement with the course material, fostering students' creativity in delivering their ideas, improving students' communication and discussion skills by building on each other's work which is resulted in significant improvements in their overall performance in the course. Further, despite some students' complaints and hesitations about the flipped classroom strategy, it is expected that once this strategy is introduced to other courses and becomes embedded into the engineering program during normal circumstances apart from the fear and uncertainty surrounding the COVID-19 epidemic, students will be more comfortable with it. Thus it will yield more performance improvements.

REFERENCES

Ayasun, S., & Nwankpa, C.O. (2005). Induction motor tests using MATLAB/Simulink and their integration into undergraduate electric machinery courses. *IEEE Transactions on education, 48*(1), 37–46.

Bao, W. (2020). COVID-19 and online teaching in higher education: A case study of Peking University. *Human Behavior and Emerging Technologies, 2*(2), 113–115.

Chu, R.H., Lu, D.D.C., & Sathiakumar, S. (2008). Project-based lab teaching for power electronics and drives. *IEEE transactions on education, 51*(1), 108–113.

Crawford, J. (2020). COVID-19: 20 Countries higher education intra-period digital pedagogy responses. *Journal of Applied Teaching and Learning (JALT), 3*(1), 1-7.

Daniels, M.W., & Shaffer, R.A. (1998). Re-inventing the electrical machines curriculum. *IEEE Transactions on education, 41*(2), 92–100.

Citation Information: Shahroury, F.R. (2022). E-Learning during covid-19 epidemic: Experience of a university from Jordan *Academy of Strategic Management Journal, 21*(S4), 1-14.

Dhawan, S. (2020). Online learning: A panacea in the time of COVID-19 crisis. *Journal of Educational Technology Systems, 49*(1), 5–22.

Erdogmus, H., & Péraire, C. (2017). Flipping a graduate-level software engineering foundations course. *IEEE/ACM 39th International Conference on Software Engineering: Software Engineering Education and Training Track (ICSE-SEET).*

George, M.L. (2020). Effective teaching and examination strategies for undergraduate learning during COVID-19 school restrictions. *Journal of Educational Technology Systems, 49*(1), 23–48.

Gren, L. (2020). A flipped classroom approach to teaching empirical software engineering. *IEEE Transactions on Education, 63*(3), 155–163.

Hinz, H., & Hasimi, M.N. (2018). Using simulation tools in power electronics courses—A case study. *10th International Conference on Engineering Education (ICEED).*

Huang, L. (2019). Integrating machine learning to undergraduate engineering curricula through project-Based learning. IEEE Frontiers in Education Conference (FIE).

Huang, R. (2020). *Guidance on open educational practices during school closures: Utilizing OER under COVID-19 pandemic in line with UNESCO OER recommendation.* Beijing: Smart Learning Institute of Beijing Normal University.

Jaggars, S.S. (2014). Choosing between online and face-to-face courses: Community college student voices. *American Journal of Distance Education, 28*(1), 27–38.

Karabulut-Ilgu, A., Jaramillo Cherrez, N., & Jahren, C.T. (2018). A systematic review of research on the flipped learning method in engineering education. *British Journal of Educational Technology, 49*(3), 398–411.

Karunaratne, M. (2018). Digital circuit simulator project at undergraduate level. *44th Annual Conference of the IEEE Industrial Electronics Society*.

Lin, Y.T. (2019). Impacts of a flipped classroom with a smart learning diagnosis system on students learning performance, perception, and problem solving ability in a software engineering course. *Computers in Human Behavior, 95,* 187–196.

Martinez, P.J., Aguilar, F.J., & Ortiz, M. (2019). Transitioning from face-to-face to blended and full online learning engineering master's program. *IEEE Transactions on Education.*

Montes, A.J.S., Castro, H.A.B., & Riveros, J.A.H. (2009). How to motivate students to work in the laboratory: A new approach for an electrical machines laboratory. *IEEE Transactions on Education, 53*(3), 490–496.

Organization, W.H. (2020). Coronavirus disease (COVID-2019) situation reports.

Paez, N.M. (2017). A flipped classroom experience teaching software engineering. *IEEE/ACM 1st International Workshop on Software Engineering Curricula for Millennials (SECM).*

Qader, M.S.M.R., & Qader, M.R. (2016). Teaching frequency modulation to undergraduate electrical and electronics engineering students using MATLAB/SIMULINK. *Journal of Advance Research in Electrical & Electronics Engineering, 3*(2), 1–13.

Ren, Y., & Wu, M. (2020). Freewheeling electronic laboratory learning with pocket instruments. IEEE Frontiers in Education Conference (FIE).

Safi, M. (2020). *Coronavirus: Jordan begins nationwide curfew for 10m citizens.* The Guardian.

Stoliarov, A.A., Kiselev, V.I., & Kuznetsov, E.V. (2020). Virtual laboratory of electric motor in the discipline of" electrical engineering and electronics. *International Conference on Information Technologies in Engineering Education (Inforino).*

Zhou, L. (2020). School's out, but classes on', the largest online education in the world today: Taking china's practical exploration during the covid-19 epidemic prevention and control as an example.

Received: 24-Dec-2021, Manuscript No. ASMJ-21-9737; **Editor assigned:** 26-Dec-2021, PreQC No. ASMJ-21-9737(PQ); **Reviewed:** 10-Jan-2022, QC No. ASMJ-21-9737; **Revised:** 17-Jan-2022, Manuscript No. ASMJ-21-9737(R); **Published:** 24-Jan-2022