

E-Learning in faculties of engineering during COVID-19 pandemic in Jordan

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Abstract : The recent pandemic COVID-19 has forced almost all governments in the globe to take stringent actions to counteract the spread of this new deadly virus. In Jordan, the government introduced the Martial Law and enforced lockdown of all activities in both of private and public sectors in the country including schools, universities and social gatherings. As a result, demand on the Internet increased sharply: working from home, on-line teaching and learning and on-line orders for different supplies. Such sudden and unexpected dramatic changes increased the load on the fragile existing network and available E-learning systems. In this study, online teaching process, in-house solutions for virtual coaching, in the faculties of engineering, was evaluated and analyzed, with focus on students' points of view. To achieve such goal, a structured questionnaire was distributed to engineering students from different levels and streams. Statistical analysis was conducted to determine the level of satisfaction of

students and testify how far the E-learning process was successful as compared with conventional classroom learning. It was concluded that students were not comfortable with this first experience related to online teaching, especially when it comes to specialized technical and practical courses as well as labs. Moreover, they faced serious problems in following up online lectures. This could be attributed to the fact that this is the 1st experience on distance learning and weakness in existing facilities and lack of awareness among students as well as staff members.

Keywords : Distance Learning, Online Teaching, COVID-19 Pandemic, Engineering Education.

1. Introduction

As well-known that the outbreak of COVID-19 started in China late last year (2019) and later spread around the world. Since then the COVID-19 pandemic has had a massive impact on people's lives, habits and economic structure in most countries around the world, including Jordan. The 1st case reported in the country was on 2nd of March 2020, for a Jordanian citizen arrived from north Italy (CNN Arabic news, 2020). As in other countries affected by the virus spreading, the Government of Jordan (GoJ) has taken severe measures to face the new and unexpected health crisis. The Defense or Martial Law was enforced on 21st of March 2020, which affected the economic and social structures and would last for a

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long time in the future. During the early beginning of the implementation of lockdown, people, especially in the central region, were allowed to go out for specific and urgent needs during specified times. Only those working in the health sector, essential public services excluding transportation and persons having special permits, issued by the National Security and Disasters Center, are allowed to move and during weekends an overall and tight curfew was imposed in the whole country as precaution to stop spreading this virus. Only people involved in the health care were allowed to move and urgent cases. Such a situation lasted until early June 2020. Jordan is among the countries that took stringent measures from the early beginning of the pandemic. However, the GoJ allowed people to return to work gradually in selected businesses such as catering and restaurants, retail shops, banks and governmental offices. Still until the writing of this paper, gatherings in public places are prohibited including universities, schools and social occasions, according to Defense or Marshal Orders No. 2 and 3 for year 2020 (Royal news TV,2020). Moreover, all other activities considered as not important or unnecessary are still prohibited except those related to food and industrial production chains. This is the first time, since the establishment of the Kingdom of Jordan that such a comprehensive and stringent lockdown was forced in the country and still until now the curfew is applied directly after mid-night and until early morning, i.e. 6:00 am on daily basis. The impacts are significant on all sectors of the economy, but losses and damages on the individual and national levels are not accurately quantified yet.

Almost all countries hit by COVID-19 took tough measures to protect people and limit the spreading of such new virus causing respiratory difficulties. However, still few research papers that discuss the impacts on various sectors and activities, including educational institutions. There are numerous of published papers related to computer supported education, yet only few studies have tackled E-learning in the faculties of engineering. Fifteen years ago, researchers from the Technical University of Cluj in Romania (Buzdugan et al. 2005), presented the performance of a new educational Internet based control engineering lab as user friendly tool. A group of researchers reported that the growth of online education will positively impact motivation and learning outcomes (Liang et al., 2008; Tsai et al., 2011) . Another researcher presented the effects of distance learning laboratories for industrial engineering education (Stefanovic, 2013). This was

confirmed by other researchers that highly structured and organized online courses can be equally effective to face-to-face classroom teaching (Driscoll et al., 2012). But another research team has claimed that blended teaching represents the best of both classroom and distance learning modes (Allen et al., 2010). A recent study, in Nigeria, aimed to assess students' readiness to accept and use alternative social media platforms and emerging technologies for online facilitation, concluded that integrating social media platforms and emerging technologies will enhance students understanding and productivity (Arulogun et al.,2020). Provided that the internet is available and signal strength acceptable, low costs and students' having good skills in using the supplementary modes of learning. In other words, new and unconventional learning styles would offer more individual attention and rich education environment that enables interaction in the classroom and encourage discovery and students' self-dependence. However, careful consideration should be paid since there are different kinds of blended courses with dissimilar ratios of contact time in the traditional classroom and distance learning.

Worldwide, some universities took the initiative and started online engineering programs few years back. For example, in 2013, a joint BSc program between the University of Applied Sciences Aschaffenburg and the University of Applied Sciences Darmstadt in Germany, in Electrical Engineering was developed as a distance learning program (Müller et al, 2013). This is considered as a special program and oriented to those enrolled in practical life, with no diploma or high school certificate, to continue their professional education: on-job learning and training. It is a unique professional education system and amid to overcome the lack of electrical engineers. Thomas Favale and others (Favale et al.,2020) reported E-learning during COVID-19 pandemic in Italy, in the campus of Poltecnico di Torino, and concluded that existing infrastructure and internet service have proved robust and copped with challenges while maintaining university operations. A Spanish team conducted a comparative study of students' attitudes towards blended and distance language learning modes in classrooms as compared with traditional classroom practices (Arrosagaray, 2019). They found that there is an increased self-perceived confidence in digital competence in the distance language learning mode and young students acknowledged the beneficial impact on their learning in the future.

Recent reports, around the world, showed that universities and administrators are struggling to formulate a cohesive plan to keep students on campus and safe from the virus. Top universities had to pivot from face-to-face instruction to remote learning due to COVID-19 outbreaks, on early 2020. A survey conducted by the Chronicle of Higher Education showed that about 22% of the surveyed universities plans to bring students to campus for in-person instruction full time for the 2020-21 academic year (Camera, 2020). Another survey described the increase of the education technology during the COVID-19, but the eLearning education cannot replace the traditional classroom in India (Kaur et al, 2021). However, the future is not clear since the recovery from the COVID-19 pandemic still uncertain around the world, including Jordan and neighboring countries. Consequently, there will be a long transition period, in which campus gathering, students' residences, in-campus food and beverage services, etc., will not be allowed since heads of universities and colleges should not ignore pleas by the health authorities. Most probably the upcoming academic year (2020-2021) will be on-line, thus, universities should re-evaluate the traditional face-to-face classes on a continuous basis. It is expected that universities are more focused towards blended courses but with strict protocols and stringent safety measures. To conclude, education experts around the world pointed out that the education process should be dynamic with the spirit of new normal: concentrate on E-learning and blended courses.

Online learning has been adopted by all universities in Jordan following instructions issued by the Higher Education Council as part of the governmental plan to face the COVID-19. E-learning has several advantages, such as being flexible and enable students around the clock access, reduced running costs for both of universities and students, and no gathering on campuses. However, one of the most important disadvantages is the high dropout rates that may hinder academic and economic outcomes. This subject was studied by a group of researchers (Coussement, 2020), and developed nomograms to give more insights into the student main drivers of online dropout. Other studies discussed the responses in different educational streams and mainly healthcare and nursing (Bradley, 2020).

Worldwide, massive online open courses (MOOCs) witnessed exponential growth during the COVID-19 pandemic (Ros et al., 2020; The

Conversation website, 2020). For example, edX organization which was founded by highly recognized universities in USA, i.e., Harvard and MIT, and Coursera, created and supported by Stanford University (Breslow et al. 2013; Sidani, 2018). In Jordan, Edraak, which is non-profit online educational platform initiative of Queen Rania Foundation for Education and Development, was established in 2013 with the aim of designing and delivering online courses to develop Arab youth throughout the MENA region (Edraak, 2020). But online learning is still considered as a new method worldwide. The first online course was developed in March 2012 by a group of professors from MIT and Harvard Universities. The prime aim of such online courses was to allow students to continue their study without traveling to campus and attend classrooms. Equally important is the flexibility to follow up online courses based on their time schedule. Edraak as an example of open online courses with a structure that is offered through an agreement between a traditional university and a MOOC provider. The aim of the platform is to give Arab learners access, in the Arabic language, to continue study at different levels with certificate. Authors personal experience, with Edraak, in preparing an online course related to renewable energy, confirm that the course was designed and prepared as lectures, then Edraak develop and produce professional formatted videos. These were posted on the Edraak platform and made available for the public. Currently, there are different online courses on Edraak platform, including computing, engineering, literature, science, etc. However, such courses are still limited in terms of subjects and depth. Hence, currently it cannot be considered as a substitute for traditional education courses: not used to pursue a degree program. In the Middle East region, MOOCs are still a new idea and not widely spread in the Arab countries because of lack of finance and well-trained human resources. Moreover, local universities should adopt strategies that guarantee spreading knowledge and information for public without expecting direct financial returns, i.e. institutional restructuring.

As stated above, E-learning is still new in the MENA region. But the unexpected sudden change in peoples' lifestyles and customs will attract attention of researchers and education policymakers to investigate more the future of E-learning in engineering and other streams. Traditionally, distance learning was not allowed in Jordan, and even, those obtained a degree from abroad based on distance learning were not accepted or their degrees not recognized and

equalized by the Ministry of Higher Education. This due to the fact that all related local regulations prohibited such scheme and students are forced to spend certain period in the study country during their study in order to consider their certificates for the equalization process (Jordan government, 2019). Moreover, local universities and colleges were not well prepared to deal with such pandemic, in terms of the required infrastructure and trained staff on E-learning systems. Thus, the current pandemic caused a 180 degrees change in the education process and pertinent issues. In this paper, the first experience in distance learning in the faculties of engineering, in Jordan, is presented and analyzed, from students' points of view. As in other countries affected by the COVID-19, in-house E-learning was adopted to support all classes, including laboratories and workshops, in the 2nd and summer semesters in 2020. To measure students' readiness and acceptance, a survey tool was used among undergraduate students. Their opinion on the newly adopted E-learning programs was assessed and analyzed. Results of the field survey were discussed in order to improve teaching and E-learning plans. It is important to mention that none of the state universities, nor the Ministry of Higher Education and Scientific Research or the Accreditation and Quality Assurance Commission for Higher Education Institutions went through this 1st experience and analyzed the outcomes. Thus, there is an urgent need to understand the pros and cons as well as existing gaps and difficulties related to distance learning in Jordan. Experts expected that the last quarter of 2020 and even early 2021, will not witness any sign of recovery from the global pandemic and it is foreseen that the impact may last longer. This was confirmed recently, by the Ministry of Higher Education, that the first (Fall) semester will be online except laboratories and practical courses (JAFRA news, 2020). Such decision removed the pressure on state universities to comply with stringent precautions, such as social distancing, consequently maximum number of students allowed in the classroom. Online teaching will help these universities to overcome current obstacles related to staff members and academic services in campuses and reduce the running expenses.

This study in hand will try to find answers for the following questions from the students' point of views about their first experience of E-learning in the 2nd semester, 2020, in the schools of engineering:

- Access to the Internet and availability of platforms and needed facilities.

- Skills to use social media platforms and emerging technologies?

- Instructors and lecturers professionalism and capability in delivering lectures using E-learning programs and/or social media platforms and their recommendations to improve the E-learning process. The study is divided into two parts: the 1st one looked at students' views and the 2nd part analyzed instructors and lecturers' feedback.

E-learning is a new field in the general and higher education levels in Jordan. Still, there are limited number of papers and reports in the open literature dealing with COVID-19 and E-learning, in the world. In Jordan and the MENA region, this research paper is the first of its kind discussing E-learning during the COVID-19 pandemic based on views of engineering students' and their recommendations. It is considered as continuation of a series of studies dealing with renewable energy education, in the BSc level of various engineering disciplines in Jordan. It is important to stress here that it is not the aim of the study-in-hand to design new courses, curricula or study plans of various engineering disciplines. Rather, it attempts to address key factors affected the 1st experience in E-learning courses as compared with traditional classroom teaching and answer the above-mentioned questions. It is expected that the results of the current work will help all stakeholders involved in the higher education, in Jordan and the Arab region, to understand well the cons and pros as well as needed actions to develop and improve the E-learning in schools of engineering.

2. Methodology

This research paper is a continuation of a series of papers in the field of energy education and training. The data collected in this field study were divided into three areas. The first one is related to availability of the Internet service for students enrolled in the Faculty of Engineering in the 2nd semester 2020 and full access to allocated E-learning platforms and systems by the university. The 2nd part concentrated on their skills level in using modern technologies and social media platforms, while the last part investigated the level of satisfaction of students about offered courses via the E-learning system and readiness of lecturers to deliver

sound teaching materials to students. The selected sample, of 582, students included all levels of students enrolled in BSc programs in the Faculty of Engineering. An Internet based questionnaire was sent to those students and the collected data through the stratified sample were exposed to descriptive and inferential analysis using the SPSS package and Minitab software. The detailed descriptive analysis was performed to all questions, charts generated from the responses, the SPSS file containing processed data, the descriptive characteristics deduced from the responses obtained and the statistical significance of the questionnaire variables in terms of reliability statistics, inter-item correlation matrix and item-total statistics were computed.

The detailed descriptive statistics are used to define the basic features of the sample data and provide a summary about the studied sample. Composed with simple charts and graphs, these form the basis of practically every quantitative analysis of data. Descriptive statistics helps to streamline big amounts of data in a workable way: each descriptive statistic reduces lots of data into a simpler summary. In this study, the Standard Deviation (σ) was used to test the data variability: a higher standard deviation shows that the distribution is not only more spread out, but also more unequally spread out.

3. Results And Discussion

The questionnaire-based survey tool was designed and employed in this study with the aim to obtain data from engineering students about E-learning process in the 2nd semester 2020. The questionnaire was administered via an online google form that was sent to students' mail. The questions are in three sections in addition to the introduction, which covered the general demographics, e.g. gender, level, specialty, etc. Answering all questions were made compulsory for students. The 1st section covers the availability of Internet service, E-learning system and educational platforms. While the 2nd part follows the students' access to available educational these social media platforms, and their skills in using such new tools and technologies. The last section contained questions related to instructors and their capabilities in delivering lectures vis the E-learning system. Collected data were used to measure students' acceptance and readiness to use the distance learning system, social media groups and other emerging technologies for their online facilitations. Students'

were requested to answer addressed questions by either (5) Strongly Agree, (4) Agree, (3) Neutral, (2) Disagree or (1) Strongly Disagree. The SPSS software package was then used to generate the descriptive characteristics of all questions.

The first experience in Jordan proved that, as in other countries, distance learning has been challenging, requiring the integration of innovative learning activities such as virtual simulations and screen-based actions and events, e.g. animations and short videos. Among the 582 students, 543 (93%) are males while only 39 (7%) are females – see Fig. 1. Of which 153 (26.3%) are graduates, after completing successfully the 2nd semester 2020. It is clear that the ratio of female students, in the studied engineering disciplines, is far less than male students. This could be attributed to the fact that female students do prefer chemical, civil, industrial, communications, computer and architect engineering but not infrastructure, electrical, mechanical engineering and alternative energy technology which are included in this study. In a previous paper it was reported that ratio of male students is far higher than female students in some disciplines in the faculties of engineering in Jordan (Alawin et al, 2016). The students' status as in the 2nd semester of 2020 is summarized in Fig. 2. Usually engineering students' in the first three years study general courses and fundamental subjects and the in the 4th and 5th years take technical and applied modules. As shown in Fig. 3 only small percentage of students were registered less than 12 credit hours in this semester. Such distribution looks normal when compared with previous investigations (Jaber et al, 2017).

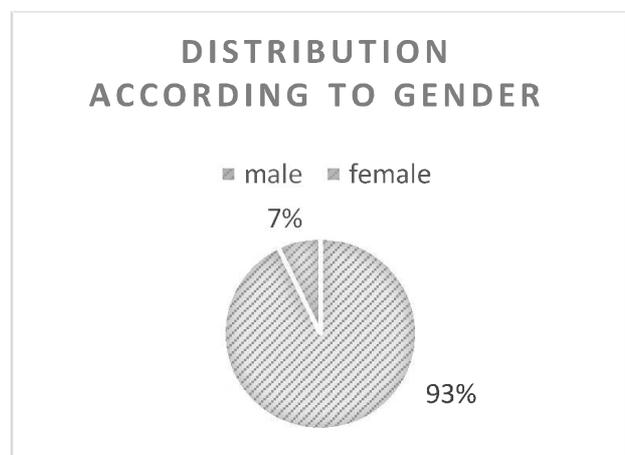


Fig.1: Gender distribution

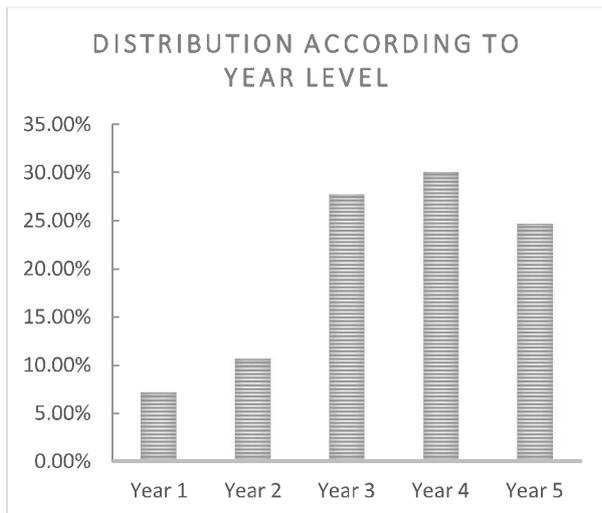


Fig. 2 : Sample distribution according to the students' level.

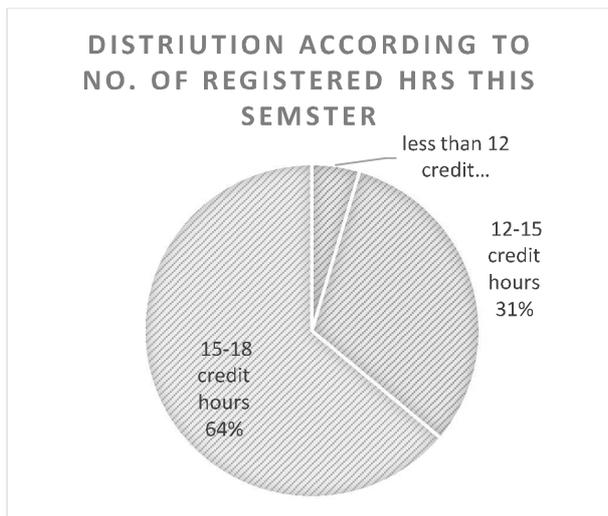


Fig. 3 : Distribution of students according to number of registered credit hours

Regardless of how the learning process is delivered online, the main goal of engineering education is to train students to think as an engineer and solve real problems in the field. Traditionally, engineering education occurred as a face-to-face in classrooms, but suddenly and without any previous preparations it was changed to E-learning, including practical classes and laboratories. This is a new experience for both staff members and students in all universities, in Jordan. In this part, the students' views and feedback about the E-learning experience is presented and analyzed. The questions were organized into five groups and each group consisted of punch of questions reflecting students' share and

learning practice on virtual studying activities. The 1st group of questions aimed to check the availability of needed infrastructure for E-learning from the students' point of views. Majority of students confirmed that the needed infrastructure for online learning was available and nearly sufficient to receive education material of various courses. Students response to each question, in this group, is summarized in Fig. 4 As can be seen in this figure answers are above average: access to E-learning platforms being the least score (3.09); availability of E-learning system on the university site (3.21) and easy access to education platforms (3.20). Such answers simply tell that students are quite happy and almost satisfied with available E-learning system which provided by the university and the open educational and social platforms. It is important to mention here that not all universities, specially privately owned, had E-learning package with suitable client-server nor access to any distance teaching tools, when the lockdown was implemented late March 2020. However, they managed to solve such a problem within short time, of between three to four weeks. State universities had E-learning system (e.g. Moodle), but limited number of staff members were well trained to use it into their courses prior to COVID-19 pandemic. It is a common practice, among engineering students in Jordan, to follow lectures, registered as videos, from other universities through special platforms that managed directly by the students' associations. Going back to the average score of 3.17, means that the existing infrastructure, in universities, for online learning still needs to be developed further in order to be more pro-active and allow direct discussions and contributions by students. Equally important, organizing and administering online exams should be expanded to enable instructors and lecturers' practicing ultimate control on students' during online exams in order to eliminate fraud and cheating. It was observed and reported by most of instructors, in both private and state universities, that students had fallen in misconduct and cheating, as well plagiarism due to lack of control on their presence, practice during exams. This was reflected on their marks, which were higher than in previous semesters. Thus, transparency gets lost in such environment as a result of no full control over individuals than previous semesters and grading will not reflect their real contribution and efforts. Here it is crucial to recommend to top management of local universities the importance of upgrading the existing E-learning systems and

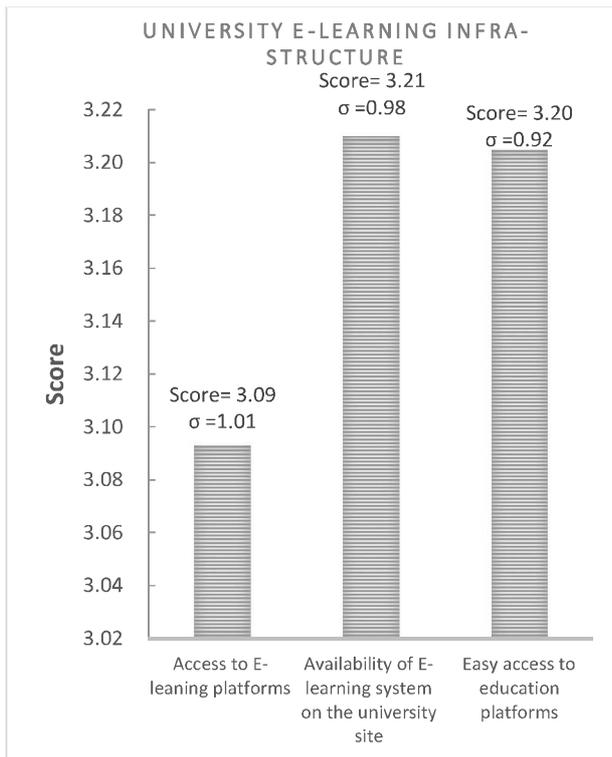


Fig. 4 : Availability of E-learning infrastructure

platforms to ensure equal opportunities, i.e. the student remains under full control, for all students during online exams. For example, modern software packages, such as the Blackboard, allows staff members to upload course materials, lectures, assignments, quizzes, exams, etc., and monitor and control students during exams through online cameras: Responds Lockdown Browser.

A. E-Learning and students' skills

Students' skills in using and dealing with the available E-learning system and other educational platform(s), provided by the university, are good enough. The majority (about 70%) of students confirmed that they could follow easily online learning courses, as shown in Fig. 5. It is clear in this figure that the average answers of students were above average, but amazingly, most students (nearly 85%) stressed that they followed all online lectures and practical courses during the 2nd semester 2020. Such percentage is higher than average attendance (around 75-80%) in traditional face-to-face lectures and could be attributed to the lockdown of the country during the period March to May 2020. Hence, students have plenty of free time, staying in home and nothing to do except watching TV and following lectures on-line. More important is that most lectures were recorded and kept available for students to download or review

on their convenience. However, in traditional classes, students are used to sharing and receiving information related to various courses during coffee breaks or contact their instructors in the university throughout allocated office hours. This informal or formal communication is lost now, since students are no longer physically gathered in one space and cannot contact the instructors directly: face-to-face.

To compare between different courses for engineering students that delivered online in the faculty of engineering and general courses in other faculties, four questions were raised to be answered by students, as follows:

- Teacher made available to students all materials related to the course
- Teachers easily communicate with students through the university platform and E-learning system
- Teachers present lectures and learning materials in a professional way
- Interaction possibility during the lecture

B. Testing of Hypothesis

We tested the following hypothesis regarding the engineering courses and general courses that delivered online during the COVID-19 pandemic. Assuming that μ_1 : mean of responses from engineering courses delivered online μ_2 : mean of responses from other faculties courses delivered online Difference: $\mu_1 - \mu_2$, H_0 : There are no differences between courses for engineering students and general courses in other faculties.

H_1 : There are differences between courses for engineering students and general courses in other faculties.

The number of samples for engineering students and general courses in other faculties are almost the same. The values of the mean and standard deviations mean are summarized in Table 1.

Table 1: Testing of Hypothesis Results Between the Engineering Courses and General Courses

Sample	N	Mean	St. Dev.
Engineering	582	3.57	0.985
Other faculties	582	3.13	0.985

Where:

N: sample size for each group

Mean: average responses for the COE and others faculties

St. Dev.: standard deviation of the mean.

We introduced the hypothesis that the two means are equal as H_0 and H_1 for the hypothesis that the two means are not equal. Where: Null hypothesis $H_0: \mu_1 - \mu_2 = 0$; where H_0 is the null hypothesis Alternative hypothesis $H_1: \mu_1 - \mu_2 \neq 0$; where H_1 is the alternative hypothesis

The absolute values of the T-Value, the P-Value and the value of the degree of freedom between sampling summarized in Table 2.

Where:

T-Value: statistical test to be compared with critical value of Student's t distribution corresponding to the significance level

P-Value: lowest level of significant at which we can decide on the hypothesis (0.05)

DF: is the degree of freedom $DF = 2N - 1$.

Since the p-Value is > 0.05 , we will reject $H_0: \mu_1 - \mu_2 = 0$, and conclude that there is a difference between the mean of COE and mean of other faculties for the delivered online courses.

Table 2 : Testing of Hypothesis Results to Show the Values of T-value, P-value and the Value of the Degree of Freedom.

T-Value	DF	P-Value
7.62	1162	0.00

communication as well as interaction with instructors for engineering courses are considered better than other general courses from students' point of view. A low value of standard deviation means that the values are close to the mean the data set. This is completely true and simply attributed to the fact that engineering courses oriented to solve problems, while the goal of general science or literature is to explain natural phenomena or events. Equally important is that engineers are more serious in work: it is clear that

lecturers in the school of engineering recorded all presentations and commuted well with students. These points are interesting and should be considered by the higher management of universities to improve the online learning, not only in engineering but all other streams and disciplines.

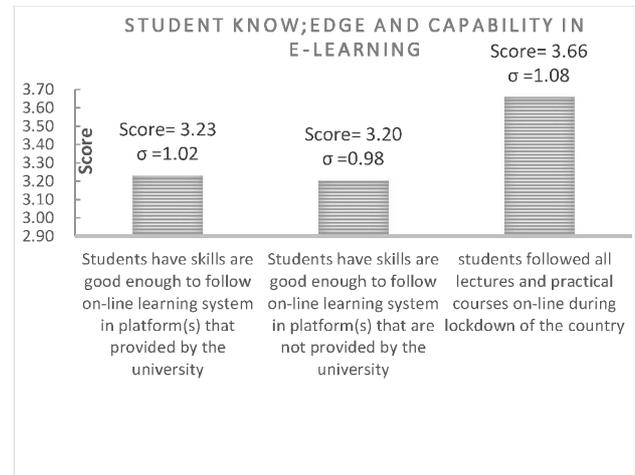


Fig. 5 : Student's skills and capabilities in dealing with on-line learning.

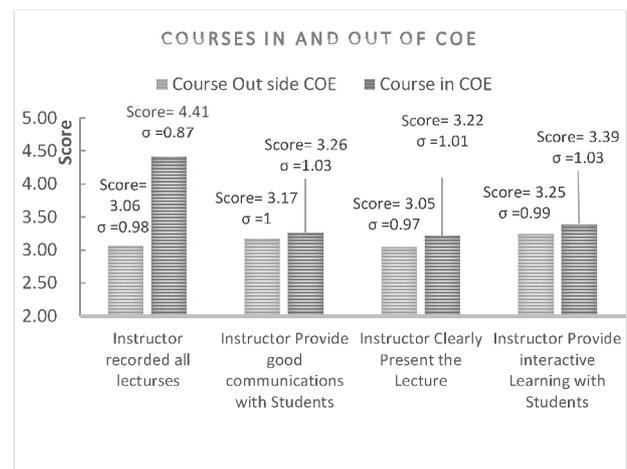


Fig. 7 : Comparison between courses in and out of school of engineering.

A. E-learning study platform during COVID-19 pandemic

When it comes to the applications used to deliver online courses, there were high similarity between the school of engineering and other faculties. As can be seen in Figs. 7 and Fig. 8, Zoom application ranked 1st and followed by the E-learning platform provided by

the university. The application Zoom was attractive because it provides virtual face-to-face between the professor and students and easy to use. Furthermore, the application can help professors to control student's notifications and interaction. The only negative feature of this application is the limited session time of 40 minutes, while lectures usually 50 or 57 minutes. However, social media applications such as WhatsApp and Facebook were not designed and developed for educational purposes, although around half of students used such applications to chat, share lecture notes and videos. Many difficulties are associated with these applications range from downloading errors, login problems, and audio and video quality, storage the video, etc. Moreover, students' attention and focus at home may be low due to the daily family needs and problems, part-time work and virtual study. In addition, the E-learning system and social media applications needs high speed Internet and without this the efficiency will drop sharply. It is worth mentioning that small fraction of

students, less than 2%, didn't use or follow E-learning courses because they do not have computers or a stable Internet connection.

In most universities, the E-learning platform Moodle and/or Microsoft Teams was used as the examination tool for all the students during COVID-19 pandemic. By using these platforms, professors could only control the exam time, i.e. starting and closing, according to general instructions of exams, time limit, type and number of questions. The only possibility to reduce cheating and copying in the online exams was creating a bank of questions and apply shuffling of questions and answers, in case of multiple choice. In the future, institutional changes are required to support E-learning. For example, establishing E-Learning and open education centers to support students and staff members is an important step towards enhancing the online education. Students, employees and teams who are not used to working or studying from home can find it difficult to keep their focus on what needs to be done and how they can contribute to their enterprises and institutions. This will take longer time to get accustomed to the new situation and concentrate on what should be achieved and how to contribute to the organization in an efficient way: without losing commitment and motivation. This is why such centers are highly needed in the near future

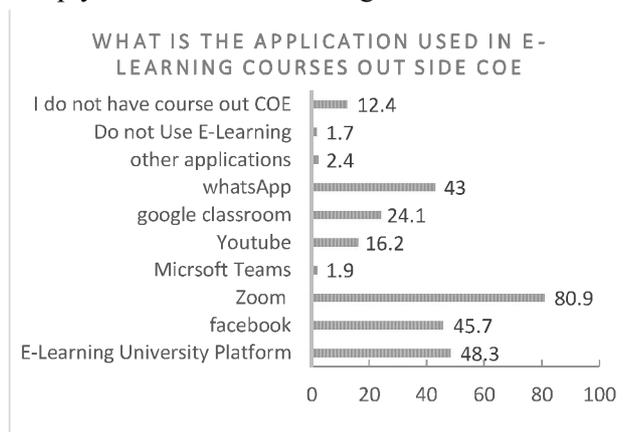


Fig. 7 : Used applications in distance learning out of the school of engineering.

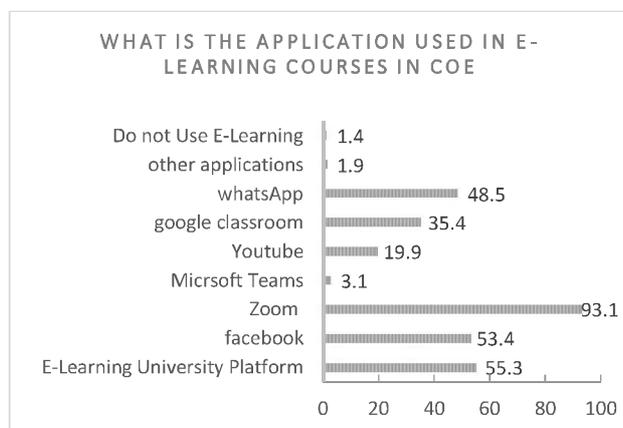


Fig. 8 : Used applications in distance learning in the school of engineering

A. Obstacles in using the current E-learning system

Fig. 9 shows feedback from students regarding their comfortability and existing obstacles of the current E-learning system. Unfortunately, almost three-quarters of participated students showed their hesitancy or discomfort in joining online courses in the future. The main reasons behind such negative feedback are (i) weakness on the Internet, (ii) poorly qualified instructors and (iii) lack of online interaction and communication with staff members. Since this is the 1st experience in E-learning, it is too early to address students' commitment and disorder at this stage, however, a significant portion of students do prefer being lazy with minimum effort towards study. It is true that the management, i.e. deans and departments heads', absorbed the excessive pressure, that created by students and staff members, during the COVID-19 pandemic and assured the continuity of the academic process. However, in Earlier studies , even before the COVID pandemic, it was reported that fresh graduate, from schools of engineering around

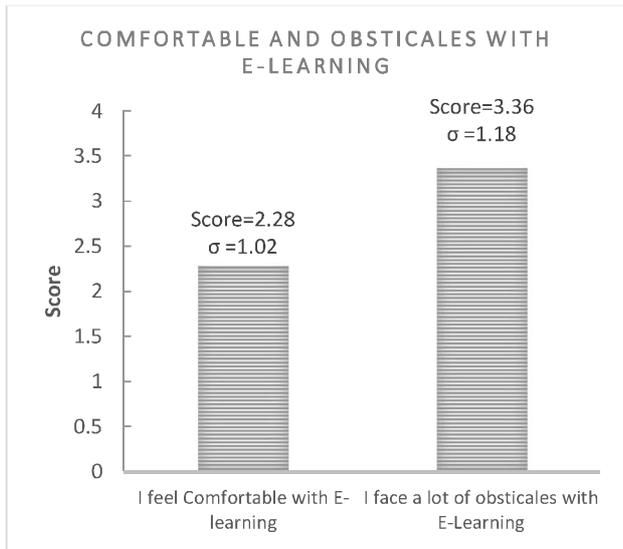


Fig. 9 : Students feel comfortable and obstacles with the E-learning system.

the country, suffer from lack of understanding of relevant engineering sciences and enjoy relatively poor technical communication skills as well as the absence of financial and managerial basics (Jaber et al., 2020). Thus, all parties involved in engineering education, in the country, should make necessary reform in the study plans and curricula to meet the market demands.

Hopefully soon, the COVID-19 pandemic will pass forever, but after leaving permanent changes in our practical and social life: the new normal. The concept of remote working or distance learning may be still new in most of developing countries, including Jordan, and therefore challenging to workers, students, companies, universities, etc. Thus, there is strong desire for improved workplace and online learning flexibility to enable all parties to organize their life in a more autonomous way.

To sum up, the institutions of higher education have received strong guidance from the GOJ about how to address this pandemic. They must follow strict policies for reopening campuses, which were shut down in March 2020, in order to protect the health of students and staff members in Jordan. Thus, all professors and instructors should have an open mind and attitude towards employing new technologies and include E-learning in their courses. It is their responsibility to incorporate the new technological developments in their field in order to avoid the risk of

teaching the students how to solve future problems with old fashioned tools: more attention should be given to modern education and E-learning in all courses including practical ones and laboratories. In the future, it is deemed to check and study readiness and satisfaction of instructors and lecturers in schools of engineering regarding distance learning in the country.

4. Conclusions

COVID-19 has woken the world up to various critical issues such as distance learning. However, the climate change is considered as the biggest pandemic of all. In light of this, it is clear that the future should be green and clean in all terms. Yet, the question remains, how do we get there with minimum negative impacts and costs? In this research, authors addressed the first experience of E-learning in schools of engineering in Jordan during the COVID-19 pandemic, covering the period from March to April 2021. The paper analyzed the levels of satisfaction of E-learning and used platforms.

This study confirmed that students have basic skills to follow up online courses through the E-learning system and other educational platforms. However, this will leave students working alone and increase their isolation from colleagues and instructors in the university. Thus, it is recommended to enhance interaction between students and instructors by using interactive learning simulations and software, especially in practical courses. It is expected that adopting and applying a hybrid education system would increase students' satisfaction and help them to develop their skills and understanding.

Finally, it is true that worldwide, the Corona pandemic has radically changed the way teams work together in companies, institutions, universities, etc. But such transition to remote working or studying will last for long time which represents a new and unknown situation that may bears various challenges. Thus, institutional developments and changes should be considered soon in all universities to guarantee the introduction of blended learning techniques in schools of engineering.

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