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Project-based Online Learning of Practical Engineering Course throughout COVID-19 Pandemic: A Case Study Analysis of MEP Electrical Systems Design Using Revit

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Abstract: In this paper, we will present our experiences and results in delivering and developing the course assessments of the engineering practical course. Moreover, we will compare and discuss the course assessment type of the engineering practical courses between the physical classes and the online classes, because we suffer in our distance learning during Covid-19 pandemic since we transferred to distance learning in February 2020 in the kingdom of Bahrain. In my last class in spring semester, I used to change my course assessments by adding the project-based assessment with 55% grade, keeping the rest of the grades for assignment, quiz, written exams and students class participation. Therefore, I can assess my students gradually using a well-defined Rubrics and I can determine the student project progression and implementation, then I can follow up and give them my feedback to enhance the project requirements and finally to achieve the course outcomes. The student project has several-linked course ILOs, and it can be implemented within three steps under the observation of the instructor. The project began with an introduction of the design concepts of a specific residential plan selected by the student, and then started to apply the architectural plan using Revit, finally create the electrical plan using MEP facilities in Revit. This modification in course assessment is very important; I consider it a successful way especially during the current situation of covid-19 pandemic after most of the educational institutions converted to distance learning. This situation needs more important requirements, not only improving the program infrastructure, but also developing your course specification which involves several aspects, such as the course ILOs, course assessment, teaching methods, course materials and learning resources.

Keywords: BIM, Electrical installation in building, MEP systems, Project-based assessment, Online learning, Practical engineering course, Application Programming using Revit, COVID-19.

1 Introduction

Since the beginning of 2020, the world has watched the news of the spread of the Corona pandemic (COVID-19), at the same time the media began circulating about the discovery of cases here and there. The world has a great disaster and crisis associated with COVID-19 that affected many sectors worldwide and caused huge damage and losses. Most governments around the world have temporarily closed educational institutions in an effort to stop and tackle the spread of the COVID-19 pandemic. The Kingdom of Bahrain reported its first case in February 2020, then the government closed all schools and other educational institutions adopting online learning. By early November 2020, over 80,000 cases and 300 deaths had been recorded [1], while the complete lockdown was not implemented. Closure of schools and non-essential businesses, have been implemented to stop the spread of the epidemic. Several countries has implemented local closures that have affected millions of students **[**2**].** Consequently, researchers have to investigate this issue. UNESCO supports countries in their efforts to reduce the direct impact of school closures, especially the most vulnerable and disadvantaged communities, and to facilitate the continuation of education adopting distance learning [3].

2 Significance of the Study

From February 26th of 2020 to present, all academic institutions in Bahrain adopted distance learning **[**4**]**. However, all academic insinuations, instructors and students have suffered. Course assessment in online or distance learning [5] was different. In face-to-face learning, it is easier to assess your students in the class/lab using classwork, assignments, quizzes, written exams, lab reports and class participation. On the other hand, in distance learning it is difficult to assess your students using the same assessment methods, so you must do some changes to overcome the problems initiated in online teaching, such as students' carelessness, challenging to make everyone active

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and, being sure that all students understand and implement what they learn specially for the practical or engineering courses, and overcoming the copy-paste problems in doing their assignments. In this paper, the author shares his good practice in developing the course assessment to achieve the course outcomes and to overcome the problems in one of his online practical engineering courses. Project-based assessment method was adopted to develop my course assessment, which is appropriate for the current situation. Based on my experience, the development of course specifications of all the courses, especially engineering practical courses, is a very important issue that you have to do. In addition, the program resources and foundations, including the digital tools and e-learning system should be upgraded to achieve the requirements.

3 Related Studies

Ting Du discussed the use of BIM technology in many aspects such as architectural design, visual simulation, schedule control and the city planning. He also focused on the main teaching models such as BIM teaching in a single course, BIM teaching in a series of courses, and BIM teaching in integrated design studio. He guided the students to explore the software innovation, enhance their understanding of BIM technology and make best use of BIM technology [6]. Charles Graham et al. developed a list of "lessons learned" for online instruction. They worked on improving the faculty members and higher-education institutions to examine their teaching practices. They used some principles as a framework to evaluate the students [7]. Y. Astatke et al. presented their experiences in developing the online courses using the internet. They delivered three different engineering core courses in Electrical Engineering program, which has online laboratory experiment using distance learning framework system. They described the required steps to convert from on campus courses to distance learning courses using specific TM Rubric. The Results showed that conducted design and laboratory experiments online were successful [8]. Salman Azhar discussed the current and future challenges, the benefits and the risks of BIM for the AEC industry. He also showed that average BIM ROI for projects under study illustrated its potential economic benefits. He recommended that the implementation of BIM must be in a proper way including the risk, data ownership and associated issues [9]. Polina Häfner et al. focused on teaching methodology for a practical course in virtual reality by simulating interdisciplinary industrial projects and developing skills such as methodological approach to practical engineering problems, teamwork, working in interdisciplinary groups and time management. In addition, they discussed the importance of the course design and the successful realization of the course. They also referred to some project examples from the past three years. Meanwhile they noticed that the motivation in a team increased so much and most students worked on the project in their spare time [10]. Robert Eadie et al. examined lecturer, employer, and student's perceptions of the best way to teach BIM in a multidisciplinary department. They also presented the way of teaching to improve student's employability [11]. Jasim Farooq et al. emphasized that BIM Electrical System Design must be introduced in attractive and effective ways at both static and dynamic levels for electrical systems. The results of the research improved the smart grid at the industrial level by combining between the historical data, energy analysis and behavioural studies using BIM System [12]. Suamit Correia Barreiro et al. displayed a potential tendency of using more advanced ways for more knowledge about generation Z. The study included presenting the difficulties and challenges facing the teachers and students. Moreover, they highlighted the needs to improve learning outcomes that improve the student's skills. They determined that there is great difficulty in linking theoretical study with the application of engineering [13]. Ana Regina Mizrahy Cuperschmid et al. in order to allow an adequate interaction, discussed that Hybrid Education required a high degree of planning, in both digital and physical environments. In addition, it was recommended to develop the web interface for the provision of digital material, including video lessons. It should ensure ease of use, system efficiency and student satisfaction [14]. Dr. Ravindra Dey et al. investigated the effectiveness of online education during the COVID-19 pandemic. The results of the study proved that inspiration is high among the teachers and students, who are equally passionate about distance learning. It was recommended that all institutes levels must back up their classes' lectures with asynchronous online courseware so the students can refer to it in their free time [15].

4 Methodologies

Project-based learning makes students feel satisfied with what their performance. Students learnt to manage their time, interpret data sets, resolve value conflicts between group members, as well as prepare and communicate the results of their research. Project-based learning provides students with the opportunity for undertaking and managing the real-life situations. Students can show and discuss the design steps with the instructor and other colleagues in the class, by allowing the students to participate in groups by specifying a case study and collecting the information required for the MEP electrical system design. Thus, during the semester, the student should submit his/her project gradually. The project consists of the following three steps. First, the project introduction including the design concept; second, the architectural plan which is a residential plan selected by the student and should be implemented using Revit software; third the student has to create the electrical plan using the default electrical template. After that, the student has to finish the design of the electrical fixture by adding the electrical panel, the sockets and the lighting. Finally, the student can collect the panel schedule of the project

5 Advantages of Using Revit for BIM/MEP Project

- The faster design can be achieved using MEP/ BIM Revit.
- Using Revit makes your design more simple along with your building model.
- Using Revit System Analysis, one can define all the required components having information like the power requirements, which means it does not need to produce physical models.
- In Revit when two objects are merged, connectivity automatically will be maintained if the objects are moved around or resized.
- If you made any changes to the model, will automatically updated using Revit.
- Using Revit MEP/BIM modelling workflow is enhanced.
- The in-built features of this software can assist in improving the productivity of project members.
- Accessing project information has become more important using Revit.
- You can collect more information of your design like the panel schedule.

6 The Course Assessments

In my practical course of electrical systems for interiors, the students must take practical lectures in the computer lab using Revit to see the student's implementation of what he/she learned. You can give them the feedback directly, then the students can submit the lab reports. In online learning, it is recommended making a modification of the course assessment by adding the project base with 55% marks as shown in Table 1.

Table 1: The modified online course assessments.

Course assessment	Marks
Assignment 1	10%
Quiz	10%
Midterm exam (written exam)	15%
Project Pre-Jury	15%
Project Progression	10%
Project Final Jury	30%
Student Participation	10%
Total	100 %

Several methods that can be used together to assess student learning with project-based assessment [16, 17, 18]. First, in my class, I used to assess my students step by step during the semester to see their project progression in the class "project progression"; second, the student has to prepare a power point presentation according to the requirements of the per-jury test which will be assessed by an internal panel from the department. The final step of the project will be assessed by both internal and external panel based on well-defined rubrics, where the student has to enhance his/her project-based on the feedback received from the instructor during the semester and by the panel comments during the discussion of the pre-jury and final jury presentation. The marks weight of each step is illustrated in Table 1. Moreover, the online course assessments [16, 18, 19] criteria and Course CILOs mapping of the project for the Pre-Jury and final jury are illustrated in Tables 2 & 3.

6.1. The Project Pre-Jury Requirements

- Open your architectural project using Revit (architectural default metric template)
- Create the architectural Plan of the building (residential building) with the main components (levels, grid, walls, windows, doors, flooring and ceiling) with dimensions
- Introduction and Design Concept Statement (written Text)
- The required IT skills using Revit
- Prepare your PowerPoint presentation

Table 2: The online course assessments criteria of the project pre-jury.

No.	Assessment Criteria	Course CILOs	Allocated Mark	Student Mark
1	Introduction and Design Concept Statement	LO 4- S-A	4	
2	Design Strategies of the Architectural CAD Plan	LO 1-K-TU	4	
3	Software Simulations using Revit	LO 5- S-IT	3	
4	Presentation & Defending	LO 7- C-R	4	
	Total		15%	

The following screen shots were taken from the pre-jury record on MS. Teams, as shown in fig.1.

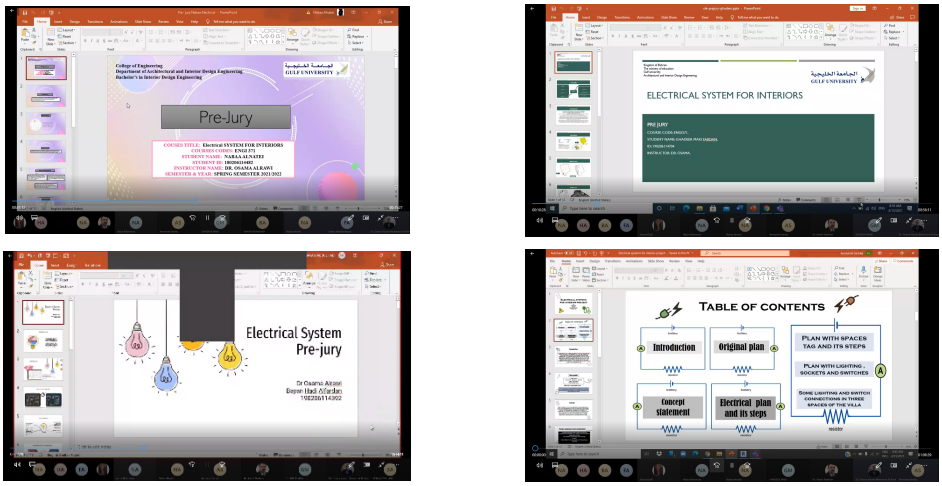

Fig. 1: The screen shot of the pre- Jury presentation of the students on Ms. Teams

6.2 The Project Final Jury Requirements

- Create your electrical project using Revit (electrical default metric template)
- Insert the Revit link of the architectural plan
- Check the alignments of the electrical plan level with the original plan level
- Specify and define the tag spaces of your plan
- Complete the Original electrical CAD Plan (the panel, sockets, lighting, etc.)
- Create the electrical panel schedule
- Prepare your PowerPoint presentation

The following screen shots were taken from the final jury record on MS. Teams, as shown in fig.2.

Table 3: The online course assessments criteria of the project final jury.

No.	Assessment Criteria	Course CILOs	Allocated Mark	Student Mark
1	Case Study Analysis, and Data Collection	LO 4- S-A	8	
2	Design Strategies of the MEP electrical CAD Plan	LO 1-K-TU	7	
3	Software Simulations using Revit	LO 5- S-IT	8	
4	Presentation & Defending	LO 7- C-R	7	
	Total		30%	

Fig. 2: The screen shot of the final jury presentation of the students on Ms. Teams.

7 Case Study Analyses

7.1 The Revit Architectural Plan

According to the project requirements, a case study of residential plan was chosen with a flat that has an area of 381 meter-square, it is located in Sanad/ Bahrain as shown in Fig. 3. The flat contains a living/dining area room that includes a restroom for the guests, two bedrooms each with its own bathroom, a kitchen that contains a small eating area, a reading room, and a storage room with a laundry room.

Design steps:

- The first step is to open the architectural template in Revit, then to start creating the flat levels and grids from the architecture tab to draw the walls easily.
- Move on to the next step, where the modelling of the walls will take place by pressing on the walls icon in architecture tab and choosing the type of wall for the project, where two different types of walls were chosen: one for the exterior walls and the other is for the interior walls inside the flat. Then, you can locate the doors and the windows into the plan.
- The floor of the flat is modelled by the floor icon present in the architecture tab, where the type of flooring can be chosen.
- The next step is to create the ceiling in Revit of the flat from the ceiling symbol in the architecture tab.
- The floor and ceiling are very important before starting the electrical plan, because some types of electrical fixtures are fixed on the floor or ceiling.
- The last step in modelling the flat is applying the furniture (this step is optional) and this can be achieved by click on the component icon in the architecture tab, where each component is selected and placed in the desired place in the plan. Now, we can say that the architectural plan is done and ready for the next step to install the electrical system.
- The architectural plan requirements are considered as the project pre-jury requirements. The students are evaluated during the semester by the instructor then by the pre-jury panel

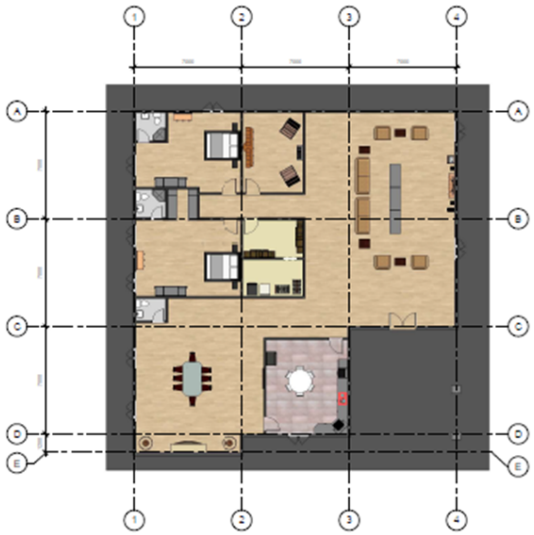

Fig. 3: The architectural plan of the Flat of 381 meter-square.

7.2 The Revit Electrical MEP Plan

To start a Revit electrical project, you must finish your architectural plan requirements, which should be a residential building based on the project requirement. However, in Revit, this plan must contain all the required elements of the building, such as the levels, grid, walls, windows, doors, floor and ceiling. Therefore, you can start your electrical project after inserting the architectural plan link in the electrical project.

The Design Steps:

- Open a new Revit project then, click on the browse button. Next choose the electrical default metric template
- From the task bar, click on insert tab to choose the link of the architectural plan file, then the link will be inserted into your electrical project.
- The next step is to click on one of the elevations from the project browser bar, then chose the east elevation to check the levels alignment between the electrical plan and the architectural plan. The levels should be aligned together.
- Then, go to the analyze tab and choose space to check the spaces tag. If it is not defined, then you must go to the link and check the room bounding box. After that, the space will fit in your plan and you can either do it manually for each room by choosing the space tag or by clicking the place spaces. Then, you can change the spaces name of each room.
- Start adding the electrical elements, such as lights, switches, panels, and sockets. First, you must insert the electrical panel by clicking the systems tab. From the electrical equipment button, you can choose the required panel to your project from the panel family, then you can place it into the plan with an elevation of 1.2 meters from the ground.

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After that, from the properties box, you should choose a certain name to this panel (panel 1).

- After finishing the previous steps, you will be ready to add the required electrical fixtures to your project. For example, if you would like to add the lighting fixtures, click on electrical from systems tab, choose the lighting type and insert it in each room as shown in Figure 4 below.
- All lighting fixtures should be connected to the panel through switches according to your design requirements; you can choose any type of switches available in the library.
- Finally, you can add the sockets, click on the systems tab then, select devices then, click electrical fixtures, and choose the socket you want for this project. The standard sockets are chosen with the required numbers in each room. Again, these sockets are connected to the panel installed in the plan as shown in Fig. 5
- The last step of the project is to generate the panel schedule, and click on the analyze tab, then the panel schedule. However, in this schedule, you can see the electrical fixtures you added to your electrical project. Everything the student, did is listed in it as shown in Fig. 6. In addition, Fig.7 represents the screen 3D shot of the living room of the project.

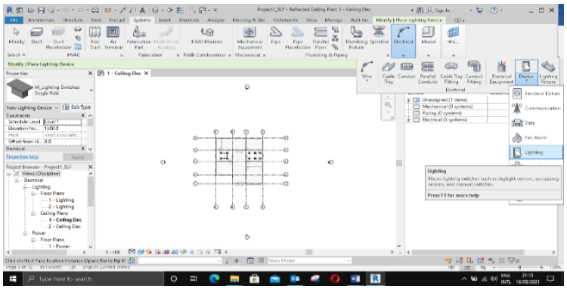


Fig. 4: Adding the lighting fixtures to the plan.

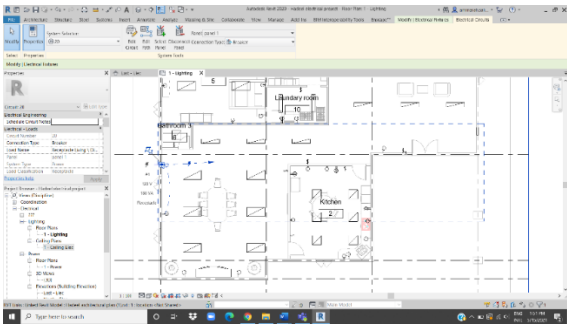
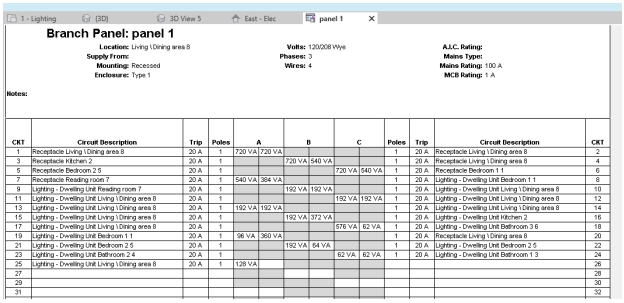


Fig. 5: The connection of the sockets to the panel.



Branch Panel: panel 1

Location: Living \ Dining area 8
Supply From:
Mounting: Recessed
Enclosure: Type 1

Volts: 120/208 Wye
Phases: 3
Wires: 4

A.I.C. Rating:
Mains Type:
Mains Rating: 100 A
MCB Rating: 1 A

Notes:

CKT	Circuit Description	Trip	Poles	A	B	C	Poles	Trip	Circuit Description	CKT
1	Receptacle Living \ Dining area 8	20 A	1	720 VA	720 VA		1	20 A	Receptacle Living \ Dining area 8	2
3	Receptacle Kitchen 2	20 A	1			720 VA	540 VA	1	20 A	Receptacle Living \ Dining area 8	4
5	Receptacle Bedroom 2 5	20 A	1				720 VA	540 VA	1	20 A	Receptacle Bedroom 1 1	6
7	Receptacle Reading room 7	20 A	1	540 VA	384 VA				1	20 A	Lighting - Dwelling Unit Bedroom 1 1	8
9	Lighting - Dwelling Unit Reading room 7	20 A	1			192 VA	192 VA		1	20 A	Lighting - Dwelling Unit Living \ Dining area 8	10
11	Lighting - Dwelling Unit Living \ Dining area 8	20 A	1				192 VA	192 VA	1	20 A	Lighting - Dwelling Unit Living \ Dining area 8	12
13	Lighting - Dwelling Unit Living \ Dining area 8	20 A	1	192 VA	192 VA				1	20 A	Lighting - Dwelling Unit Living \ Dining area 8	14
15	Lighting - Dwelling Unit Living \ Dining area 8	20 A	1			192 VA	372 VA		1	20 A	Lighting - Dwelling Unit Kitchen 2	16
17	Lighting - Dwelling Unit Living \ Dining area 8	20 A	1				576 VA	62 VA	1	20 A	Lighting - Dwelling Unit Bathroom 3 6	18
19	Lighting - Dwelling Unit Bedroom 1 1	20 A	1	96 VA	360 VA				1	20 A	Receptacle Living \ Dining area 8	20
21	Lighting - Dwelling Unit Bedroom 2 5	20 A	1			192 VA	64 VA		1	20 A	Lighting - Dwelling Unit Bedroom 2 5	22
23	Lighting - Dwelling Unit Bathroom 2 4	20 A	1				62 VA	62 VA	1	20 A	Lighting - Dwelling Unit Bathroom 1 3	24
25	Lighting - Dwelling Unit Living \ Dining area 8	20 A	1	128 VA								26
27												28
29												30
31												32

Fig. 6: The panel schedule.

Fig. 7: The 3D shot of the living room.

8 Conclusion

Throughout the outbreak of COVID-19 pandemic the educational institutions in the world have adapted digital or online classes. As a conclusion in this research, we would like to focus on the results obtained by changing the course assessment of the practical engineering course by using project-based assessment. However, as discussed in this paper, the project-based assessment that achieved 55% involved three types of assessment. Frist, the instructor assesses his/her students step by step during the semester to see their project progression in the class" project progression "; second, the student is required to prepare a power point presentation according to the requirements of the pre-jury test which will be assessed by an internal panel from the department; third, the project will be assessed by both internal and external panel based on well-defined rubrics. According to the final jury requirements and after the students receive the feedback from the instructor gradually during the semester and from the panel after the pre-jury, they can submit the final project with a presentation on MOODLE. Definitely, there is an oral discussion during the pre-jury and final jury using a clear rubric, so we can discuss then assess the students successfully. The instructor will take the benefits, so he/she can have follow-up with the student, as well as the project progression and, implementation of its requirements. With such type of courses in engineering programs, it is recommended to adapt the project-based assessment. Moreover, its marks percentage should be between (50-70),

to achieve the required course outcomes. Finally, it is recommended by the instructors to develop and review the course specifications of all the practical courses when adapting online learning.

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Conflict of Interest

The authors declare that they have no conflict of interest.

References

[1] G. Abdulla, Deema Almoayyed, Fatima Alsebaie, Omar Al-Ubaydli, Nidhi Arun and Sara Bahman, *The Impact of the Covid-19 Pandemic on the Bahrain Private Sector*: Proceedings from a Roundtable Discussion, Bahrain Center for Strategic, International and Energy Studies., 1-22, (2020)

[2] M. Billy, *The Influence of Dynamic Organizations and the Application of Digital Innovations to Educational Institutions in the World during the COVID-19 Pandemic*. Published by Elsevier. Available at SSRN: https://ssrn.com/abstract=3588233., 1-11, (2020)

[3] UNESCO School Closures Caused by Coronavirus (COVID-19), https://en.unesco.org/covid19/educationresponse, [Accessed: 06-May-2020], (2020).

[4] A. Keshk. *Gulf States and the Management of the Covid-19 Crisis*. Bahrain Center for Strategic International and Energy Studies, (April)., 1-14, (2020)

[5] B. Bensaid and Tayeb Brahimi. *COPING WITH COVID-19: Higher Education in the GCC Countries*. RII Forum. Athens. (April 15-17). #72. 1-19, (2020).

[6] T. Du. Study on Teaching Method of BIM Technology in Universities. *Journal of Educational Theory and Management.* Binzhou University, Binzhou, Shandong, 256600, China (October), 1-48, (2017).

[7] C. Graham. Kursat Cagiltay. Byung-Ro Lim. Joni Craner and Thomas M. Duffy. *Seven Principles of Effective Teaching: A Practical Lens for Evaluating Online Courses*. The Technology Source at the University of North Carolina, (March/April), 1-5, (2001).

[8] Y. Astatke1, J. Ladeji-Osias1, C.J. Scott1, K. Abimbola1, and K. Conner, Developing and Teaching Sophomore Level Electrical Engineering Courses Completely Online, *Journal Of Online Engineering Education*, **2(2)**, 1-10, (2011).

[9] S. AZHAR, Building Information Modeling (BIM): *Trends, Benefits, Risks, and Challenges for the AEC Industry, Leadership and Management in Engineering*, American Society of Civil Engineers (June), 241-252, (2011).

[10] P. Häfner. Victor Häfner. and Jivka Ovtcharova. *Teaching Methodology for Virtual Reality Practical Course in Engineering Education*. Germany, Karlsruhe 76185: International Conference on Virtual and Augmented Reality in Education, Published by Elsevier, (November)., 251-260, (2013).

[11] R. Eadie. David Comiskey and Mark McKane. *Teaching BIM in A Multidisciplinary Department*. Conference: Education, Science and Innovations At: European Polytechnical University of Ulster, Pernik, Bulgaria, Volume: Session 1, June., (2014).

[12] J. Farooq. Paawan Sharma and Sreerama Kumar R. Applications of Building Information Modeling in Electrical Systems Design. *Journal of Engineering Science and Technology Review*, **10(6)**, 119- 128, (2017).

[13] S. Correia Barreiro and Daniel Fernando Bozutti. *Challenges and Difficulties to Teaching Engineering to Generation Z*. Universidad San Ignacio de Loyola, Vice-Chancellorship for Research, (August).,128-153, (2017).

[14] A. Regina Mizrahy Cuperschmid and Caio Magalhães Castriotto. *Teaching BIM modeling in the architecture course: using a Blended Learning Strategy*. xxii congresso da sociedade iberoamericana de gráfica digital, 22th conference of the iberoamerican society of digital graphics 7-9, (November), 1-6, (2018).

[15] R. Dey, Dr. Indu Sharma, Neha D'Souza, and Glovin Kumar. *How effective is online Education during the Current Pandemic Due to COVID-19*. Xavier Institute of Management and Research, Mumbai, Strategic Management and Planning, ZES, Pune, Maharashtra, book chapter, 1-11, (2021).

[16] A. Abdollahi, Ali Labbaf, Mahboobeh Khabaz Mafinejad, Maryam Sotoudeh-Anvari, and Farid Azmoudeh-Ardalan, Online Assessment for Pathology Residents during the COVID-19 Pandemic: Report of an Experience, *Iranian Journal of Pathology,* ISSN, 2345-3656, (2021).

[17] M. Kumar Saxena and Nitika Sharma, "Online Teaching During COVID-19 Pandemic Era : Challenge or Opportunity for Higher Education Teachers", International *Journal of Education and Allied Sciences*, 12(2), 1-10, (2020).

[18] H. S. Mirza, "University Teachers' Perceptions of Online Assessment during the Covid-19 Pandemic in Lebanon", *American Academic & Scholarly Research Journal*, 13(1), (2021).

[19] Sihite M., Supriyanto S., Sitompul D. P., Dalimunthe D. M. J., Octavianus H., Taslim T., Dilham A., Sipayung R. C., & Dalimunthe R. F. Online lectures during the COVID-19 pandemic :conceptual analysis. *International Journal of Business, Economics & Management*, 4(1), 256-261, (2021).

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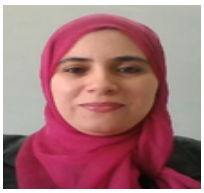

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She had 11 years of teaching experience in different countries, the most recent experiences from Canada, USA and the Kingdom of Bahrain. Her Research Field of Interest covers Smart And Sustainable Building, New Trends In Architecture. Dr. Elzefzafy is an Assistant professor at Interior Design Engineering at Department-Gulf University, Bahrain. She had done her Ph.D. in Architecture Engineering Department, from Sherbrooke University, Canada. My Bachelor's and Master's degrees from the Architectural Engineering Department, Cairo, Egypt. She had 11 years of teaching experience in different countries, the most recent experiences from Canada, USA and the Kingdom of Bahrain. Her Research Field of Interest covers Smart And Sustainable Building, New Trends In Architecture Design, Building Technology, Educational And Pedagogic Development. Her specialization is in the area of Architecture Design, Advanced Composite Materials, Sustainable Development, Construction System, Dr. Hend also is a member of the following professional organization: FHEA: Fellow of the Higher Education Academy, Institution of Engineering and Technology- UK IET, Egyptian Engineers Syndicate, and Bahrain Society of Engineers.

Hadeel Al-Kurdi, I am a student at Gulf University. I am in my third year at Interior Design Engineering, I can work under pressure and I am a fast-learner and enjoy developing my technical skills and gaining knowledge. While in my last semester I got a membership at IET (The Institution of Engineering and Technology). I am daily inspired by my doctors. In my free time, I like to spend time with my family and friends.

Ammarah Salimah Saddiq is a 22 years old, American third-year student at gulf university who is majoring in interior design engineering. She is also an IET member who has been participating in doing research since high school. She speaks two languages (English and Arabic) and is a creative person who enjoys trying new things and gaining new experiences she has worked with children of different ages and when she isn't studying she likes to read, cook, swim and draw, she also has a certificate for attending the sustainable interior design week form UGREEN.