Advances in Engineering Education

FALL 2020 VOLUME 8 NUMBER 4

Online Studio Experience for a Second Year PODBL Unit on Power Engineering Design during COVID-19

APEL MAHMUD
Deakin University
Geelong Waurn Ponds, Victoria, Australia

ABSTRACT

This paper discusses the experience of online studio activities for a second year project project-oriented design-based learning (PODBL) unit. The experience of delivering campus-based studio activities through an online platform, to a design a small power system, is shared due to COVID-19 restrictions. The student experience is benchmarked with previous year along with potential benefits and challenges. Preliminary results demonstrate that the students performed almost in a similar way (slightly better) in 2020 as compared with 2019 and the workloads for support staffs are significantly reduced.

Key words: Online studio experience, project-oriented design-based learning (PODBL), power engineering design

INTRODUCTION

Bachelor of Engineering (Hons.) courses within the School of Engineering at Deakin University, Australia are designed by focusing the project-oriented design-based learning (PODBL) approach. In PODBL units, students usually learn through projects in collaborations with other students within these units. Another key feature of these units is the studio activities which help students to practically validate their concepts, thus, providing them real-world experience. At the same time, these activities allow students to identify the differences between theories and practices.

The School of Engineering at Deakin University has a long history of remotely delivering all teaching units for all major undergraduate courses through its cloud campus. Generally, all cloud students come to the campus for completing their studio activities and stay around the campus for a week (mainly, referred to as the intensive week) depending on the number of units they enroll in a trimester. For PODBL units, the studio activities are designed for up to two days. At the same time, teaching units are delivered face-to-face for campus-based students where studio activities for these students are distributed over effective teaching weeks. However, the COVID-19 pandemic has changed the whole world and restricted people to work from home. Hence, all studio activities had to shift from physical laboratory-based activities to online software-based activities.

This paper particularly stresses the challenges faced to deliver studio activities (from campus-based to online) during COVID-19 pandemic for a second year PODBL unit on Power Engineering Design (PED) within the Bachelor of Electrical and Electronics Engineering (Hons.) course at Deakin University, Australia. The other challenges include student engagements in groups and managing time. Furthermore, this paper addresses how some of these challenges are overcome and can be implemented ~~in~~ for the future delivery of the PED unit.

METHODS

Studio activities for the PED unit require students to design a small three-phase power system that includes a power supply as a generator, a step-up transformer, a transmission line, a step-down transformer, a distribution line, and a load. As a part of this project design, students need to analyze the underlying characteristics of each component and align their findings with the fundamental theories related to power engineering. Finally, students design the whole power system by combing all components together with different configurations. Hence, six structured studio activities are designed to help students for gaining a clear understanding about these individual components and students then work on their own projects to design the whole system.

As the COVID-19 pandemic did not allow students to physically do studio activities in the laboratory, campus-based studio activities were transformed into simulation-based activities using similar sets of equipment. Studio activities in the PED unit are designed using equipment from a supplier called, LabVolt. The supplier of these equipment has a virtual laboratory called, Electromechanical Systems Simulation Software (LVSIM®-EMS) which has exactly a similar configuration to that of the physical power lab at Deakin University's Geelong Waurn Ponds Campus. However, the main challenges aroused when it was identified that the LVSIM®-EMS does not include all equipment (e.g., the wattmeter) required to do these activities. Furthermore, some equipment does not work when putting all components together to design the whole power system. However, these issues are solved using data acquisition for measuring power instead of using the wattmeter and identifying components that work properly for the whole configuration of the power system needs to be designed.

As indicated earlier on, another challenge was engaging students in these studio activities. Since the PED is a PODBL unit, students required to work in a group and it was extremely difficult to get all (both campus and cloud-based) students together at a time to complete these activities. Different channels in *Microsoft Team* were created for the group where students were able to collaborate with each at their convenience rather than making themselves available at a specific time. It is worth noting that the total number of enrolled students in the PED unit was initially 72 and finally, there were 51 students after the withdrawal of 21 students due to problems related to COVID-19. Each group had 3 to 5 students and there were 13 groups at the end.

PRELIMINARY RESULTS

All students within the PED unit were assessed for these studio activities through an assessment item called, *practical project validation* where they need to orally demonstrate their project. They are basically assessed against different criteria that include skills for connecting different components, understanding the underlying theories, characteristics of the system under changing conditions, oral communication, and occupational health and safety. While comparing with the previous year, the students seemed to be more confident as they had the opportunity to flexibly perform these activities and collaborate with each other. Last year (2019), more than 45% of students (i.e., 25 out of 54) requested the second attempt while this has been reduced less than 30% (15 students out of 51) in 2020. The second attempt was provided to students who were much closed to meet the minimum expected standards such as almost clear concepts for connecting different components and nearly clear theoretical understanding that can be overcome with some additional supports. With this virtual platform, no significant differences are found in scores for the *practical project validation*. The average marks for this assessment in 2019 and 2020 were 20.7 and 21.9 out of 30, respectively; though there are slight increases this year. Furthermore, the technical staff of the lab was crazily busy in helping these students in 2019 while the technical support was very minimal this year. The main reason behind this is that students were coming to technical staffs in 2019 for additional practices and booked time with them. However, this has been significantly reduced in 2020 as either some students within the unit or the lab demonstrator provided a recording of the activities in *Microsoft Team* and they used these without asking help from the technical staffs.

NEXT STEPS

The conversion of physical laboratory-based studio activities into the online virtual simulation platform has provided the opportunity for students to learn at their own time rather than waiting for the scheduled studio time over the teaching week or during the intensive week. In the future, these virtual activities will be promoted to both on campus and cloud students. Through this virtual platform, students will be able to develop their skills even before coming to the studio. For this, they can use the recordings from this year and thus, the workload for the technical staffs as well as the lab demonstrator will be significantly reduced.

The cloud students are mostly working in the power industry for several years in different roles such as electricians, power plant operators, maintenance workers, linemen, etc. They usually enrolled for the Bachelor of Electrical and Electronics Engineering (Hons.) course at Deakin University for upskilling. From the past experience with these cloud students and also from their scores in the practical project validation, it is evident that they do really much better than on-campus students. For example, the average marks for cloud and on-campus students in 2020 were 22.57 and 21.47 out of 30, respectively. Since most of the cloud students have already got extensive experience and they do not have issues working with these equipment, the intensive week activities for the PED unit can be completely converted into online so that cloud students do not need to travel to the campus as their key technical knowledge can be assessed in the virtual platform. Actually, cloud students recognize this as a potential benefit and a question was asked about their preference between activities based on the campus and virtual LVSIM®-EMS during their *practical project validation*. Almost everyone was in favor of the virtual LVSIM®-EMS. However, it would be potentially valuable to ask cloud students about their desire for an on-campus physical experience before completely shifting into fully virtual activities and providing them an option to choose. In the future, the weekly scheduled studio activities for the on campus can also be reduced by encouraging students to work through this virtual LVSIM®-EMS. Having said all these, the main limitation of the virtual activities is that the LVSIM®-EMS will deprive engineers ofgaining some hands-on experience which they achieve through physical lab activities.

AUTHOR

Apel Mahmud received his PhD in Electrical Engineering from the University of New South Wales, Australia and a Bachelor Degree in Electrical Engineering from Rajshahi University of Engineering and Technology. He also holds an MBA degree from Australian Institute of Business. Currently, he is a senior lecturer in electrical & renewable energy engineering at Deakin University, Australia. He has served as a lecturer in electrical & electronic engineering at Deakin and Swinburne, a research fellow at the University of Melbourne, and a research publication fellow at the University of New South Wales. Dr. Mahmud was the chair and treasurer of IEEE Power & Energy Society (PES) Victorian Chapter. He is currently serving associated editors of IET Renewable Power Generation, IEEE Access, IEEE Systems Journal, and IET Generation, Transmission and Distribution.