Real Application of Transformative Approaches for

Teaching and Learning in the 21st Century

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Special Dedication

This book is dedicated to UNIMAS academicians who work hard in conducting the best teaching and learning experience. This book is hoped to be an inspiration to educators on how to implement the teaching and learning process more effectively.

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Preface

"It's not just learning that's important. It's learning what to do with what you learn and learning why you learn things that matter." -Norton Juster

The Real Application of Transformative Approaches for Teaching and Learning in the 21st Century book was produced to appreciate the transformative work of lecturers in teaching and learning. This book is expected to serve as a guide to other lecturers in helping them to improve their teaching approach, delivery, and assessment of their courses. Lecturers can also use this book to develop their ideas and creativity in designing teaching and learning according to current needs and align with the learning outcomes of the course.

Global changes in the twenty-first century have altered the landscape of teaching and learning, particularly in delivery methods, approaches, and assessments. This is due to the fact that the student body is made up of generation Z, who have different styles of learning than that of the lecturers. Conventional methods used by lecturers are no longer an option for today's students. Therefore, lecturers must transform their teaching and learning in order to be relevant to today's students.

The combination of transformative approaches introduced becomes the strength of this book's content. Authors combine diverse approaches, delivery, and assessment in teaching to ensure the effectiveness of teaching to students. Moreover, the collaborative approach used provides an alternative for lecturers to minimize the burden on students for courses taken. This approach has the potential to have a greater impact, particularly in terms of student understanding of learning.

The element of creativity incorporated is also a strength of this book. Authors explain some terms and concepts using diagrams and figures to help the reader understand. The steps and procedures for carrying out teaching and transformative approaches are stated in a systematic manner to help the reader understand what is being conveyed.

The book also includes writers from various backgrounds. This distinguishes it as a unique and comprehensive manuscript. Readers are guided through conceptual and practical understanding of teaching and learning methods. The author's presentation of basic concepts and applications can help the reader understand knowledge more deeply and broadly.

Crafting a learning environment where students are able to explore and understand how the physical world works, and to connect complex scientific concepts to their daily lives is vital. It also includes building students' confidence in their ability to solve challenging problems and empowering them to build a better future for themselves and others. CTS is one of a better way of learning that will prepare students towards focusing on being very collaborative, self-motivated and self-directed all the time staying true to the lifelong learning values, which are imperative to carve a better future for the students in their field of choice.

The next project is related to the environmental issues relating to solid waste, wastewater, and hazardous waste viewed in the context of their treatments. This course has been implementing service learning (SULAM) as a part of an immersive learning approach since Semester 2, 2017/2018. In the previous years, i.e. 2017/2018, and 2018/2019, the

course assessment included either a final examination (40%, session 2017/2018), or a mid-term examination (30%, session 2018/2019). Although SULAM implementation in this course has generally improved the CLO achievement since 2017/2018, the pen and paper examination has resulted in some students not achieving the intended CLOs. Instructors were not sure on the effectiveness of examination in creating a deep learning experience for students.

Therefore, in semester 2, 2019/2020, mid-term examination was replaced with case-study analysis to (1) encourage higher order thinking skills among students and (2) cultivate the sense of commitment and responsibility among students to find innovative solutions towards waste management issues. In addition, students' e- SULAM projects as well as group discussion and engagement with target community were implemented on online platforms. Students' reflection on their e-SULAM projects was recorded on their e-portfolio. Implementation of immersive learning through blended learning in this course has resulted in improved CLO achievement as compared to the past two years. Students' reflection on their learning experience in this course implied the effectiveness of immersive learning (blended learning) approach in this course.

Besides that, the project involved transforming the typical class lecture into an interactive scientific communication environment. Students were exposed to the real scientific communication via workshop-style delivery, project-oriented problem-based learning (PoPBL) on proposal writing projects, and brainstorming/discussion activities during weekly meetings. The initiative eliminated the traditional lecture and end-of-semester assignment practices.

Another project is MATHX Project, a new project-based learning instrument that allows digital students to work collaboratively, purposely implemented to develop teamwork and student's management skills. Students translated acquired knowledge to applications and STEM projects. The integration of digital technology used in this project helps students create meaningful and enjoyable learning experiences in Mathematics.

The following project is related to the assessment in learning. In order to improve learning via assessment conduct, assessment must be objective, significant, and magnitude. OSPE has/have been adapted and implemented for Biology students in Centre for Pre-University Studies to assess know-what and know-how practical competencies following the objective and structured manner with direct observation of the students' performance. The assessment provides meaningful learning experience to the students as it can assess all three domains (cognitive, affective, and psychomotor).

Furthermore, the enriching immersive learning experience during movement control order (MCO) was possible through blended learning substitution method. Finally, one project is related to social media and animation software offering several attractive features that may overcome the limitations of the existing educational portals. The team introduced the use of YouTube, Instagram, and Doodly as supplementary platforms for teaching Environmental Biotechnology in Semester 2 2019/2020 which resulted in excellent academic performance and positive feedbacks from the students.

Finally, this book discussed also describe the course MDP30609 Community Medicine and Public Health posting, the assessment has been modified by adopting the Alternative Assessment method. The Alternative Assessment is regarded as comprehensive, where it assesses the candidates' ability to integrate writing task and performance, divergent thinking in solving problems and enhancement of meaning skills.

Acknowledgement

First of all, we are very grateful to the Deputy Chancellor Prof Datuk Dr Mohamad Kadim bin Suaidi and Deputy Vice Chancellor (Academic and International) Professor Dr Ahmad Hata bin Rasit for their support and opportunity in producing this book. This gratitude also goes to the Director of CALM, Dr Kartini binti Abd Ghani for her encouragement throughout the journey of realizing this book. We would also like to extend our acknowledgments to the Deputy Directors (Teaching Advancement), (Learning Technology), Coordinators and all administrative staffs in CALM for the support.

Thanks to all award recipients who have contributed to the chapters of the book. They are Associate Professor Dr Cheah Whye Lian, Dr Kuryati binti Kipli, Dr Melody Kimi, Mohamad Faizuan bin Mat, Abdul Halim bin Hashim, Dr Chung Hung Hui, Dr Norazlina binti Bateni, Ahmad Alif bin Kamal, Dr Yvonne Michelle Campbell, Nor Hayati binti Jaya, Dr Rafeah Wahi, Professor Dr Zainab binti Ngaini, Norhunaini binti Mohd Shaifullah, Rohaiza binti Daud, Associate Professor Dr Afzan binti Ahmad Zaini, and Dr Nurashikin binti Suhaili. Not to forget to everyone who have been involved directly or indirectly in producing this book, our deepest appreciation goes to all of you.

Transforming Physical Hands-on Laboratory Practice to Remote Laboratory Experimentation: A COVID-19 Experience

Norazlina Bateni, Rosmina Ahmad Bustami, Al Sidqi Hassan, Dyangku Salma Awang Ismail, Md Abdul Mannan, Mohammad Sapian Mohamed Kasim, Mohd Zaidi Serah

Summary/Synopsis of Project/Initiative

KNS 2601 is a laboratory course for Hydraulics and Geotechnical taught to Second-year students. The course exposes students to the technical background of hydraulics and geotechnical standard tests. Students are expected to comprehend and apply the principles of analysis and the scope of works in the hydraulics and geotechnical field. It is aimed to enhance students understanding from hands-on experience through standardized procedure and equipment provided in the laboratory. The experiments conducted are open-ended laboratory experimentations, where students need to come out with their own procedure and hypothesis. The course covers the psychomotor domain of P4 (Mechanism) and Critical Thinking (CT) skills. However, due to the COVID-19 pandemic, the instructors needed to outline a practical solution that could satisfy the outlined learning outcomes and expected taxonomies as quickly as possible. The pandemic hit us during the mid-semester break, when most students have completed half of the laboratory experiments (total of eight laboratory sessions) – leaving the course half-finished. Hence, a digital-based learning experience with an introduction to virtual laboratory

practice was introduced. Demonstration videos were prepared for students to access and 'experience' the experiments whilst not being physically present in the laboratory.

Project Rationale

Laboratory subject is conducted to enhance students' learning experience through hands-on experimentation in the laboratories. In Faculty of Engineering UNIMAS, the open-ended laboratory practices are conducted to provide an authentic learning environment, to explore student's creativity through the preparation of their own set of hypothesis and method of experimentation. However, during the COVID-19 pandemic, students and instructors were unable to attend the laboratory sessions as per usual. Hence, there is a need to utilise the digital platform learning that can satisfies both the course's learning outcomes and taxonomies outlined. Hence, a transformation is required to cater for a new-age learning experience for laboratory courses.

Philosophy of Teaching and Learning

Mackay and Fisher (2014) mentioned that online learning has been successfully integrated into remote labs, video demonstration and web conferencing in Engineering and Science Education. The hands-on procedures of a laboratory-style to video demonstration of these same procedures have long been used to supplement lecture in teaching and learning. A study by U.S Department of Education (2009) found that students in online learning platform performed better than the face-to-face instruction. This study was used as a basis for digital platform learning experience applied in KNS 2601 Civil Engineering Laboratory 4. It was designed and developed to allow students to perform their observations through demonstration and video watching and to increase their conceptual understanding.

Approach

The standard practices for laboratory courses are through hands-on and practical experiences in physical settings. The transformation for digital platform is required due to recent COVID-19 situation where the University campus was inaccessible to students and with other restrictions in place (MCO). To ensure the continuation of the teaching and learning practice while preparing students for optimum psychomotor experiences within the limited resources, traditional laboratory approaches were modified, transformed and adapted. The instructors pulled together available resources (laboratory equipment, laboratory manuals, digital media and e-learning platforms) to create an innovative approach for students' learning experience. Video demonstrations for each of the laboratory experiments were developed to enhance their observations and understanding in each of the laboratory practice.

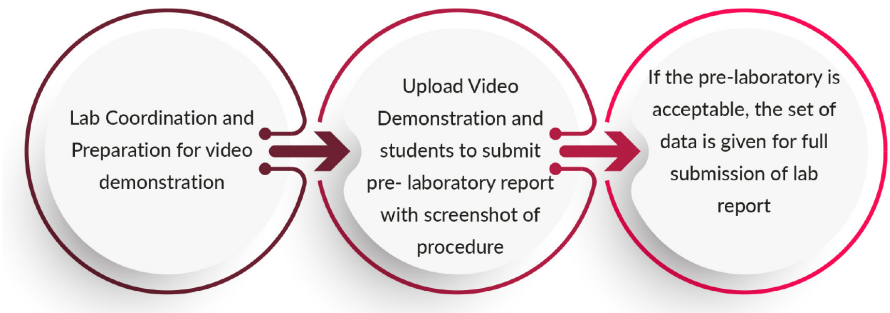

Diagram 7 - Framework Flow Chart

Figure 1 illustrates the flowchart on the application of video demonstration in KNS2601 Civil Engineering Laboratory 4 Course. The students need to submit their pre-laboratory procedure consisting of the hypothesis and procedure including screenshots of the step-by-step procedure in the video demonstration. This ensures students to view the video and observe how the experiment is conducted. Next, upon approval of the pre-laboratory, the students are given the set of data to analyse, interpret and provide the discussion of the results and submit the report writing

in eLEAP or via email. Finally, at week 14, students sat for the online test to assess the outcomes of the laboratory experimentation. In Figure 2, the work cycle is simplified to include the problem solving and solution.

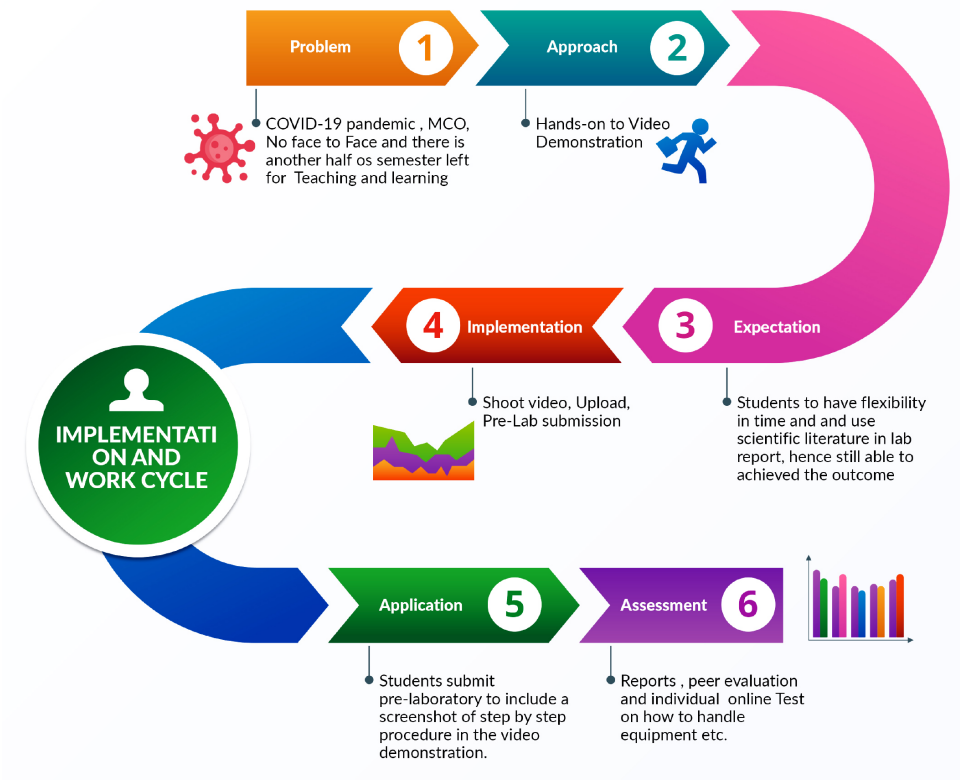

Diagram 8 - Implementation and work cycle

Video demonstration provides significant difference through virtual learning experience to students as compared to hands-on practice (Kidron & Lindsay, 2014). Through video demonstration, students can view and make observations anytime and at any place at ease. The video learning experience provided students with time flexibility allowing students to communicate with their group members and complete the laboratory report without compromising the standard. On the other hand, students

are expected to develop and accumulate their experience from scientific literature in open-ended laboratory practice. Therefore, the combination would provide future-ready students in the digital era.

Students' Engagement/Involvement

KNS2601 Civil Engineering Lab 4 course covers the cognitive and psychomotor skills. The course is assessed using the open-ended laboratory and technical report. Furthermore, in the current digital era, the critical thinking process is no longer restricted with the introduction of digital platforms to research enabling searching of answers to the technical questions. This course went through a significant transformation in terms of the psychomotor and affective skills learning due to the sudden restriction as the result of the COVID-19 pandemic. Their learning experience was enhanced through video demonstration prepared for each of the experiments where they are able to observe and view how the laboratory was conducted and meet the learning objectives. With the set of data given to the students, they continuously worked together as a team to analyse the data and prepare the technical report. The course learning outcome also assessed the students' ability to work as a team member or the team leader in a group. Therefore, the students were required to communicate between group members and with other groups to ensure successful achievement of the outcome and experimentations. At the end of this course, peer evaluation was conducted, where students' will need to rank their group members based on the commitments given in completing the laboratory work and report writing. There were 26 groups with less than 5 students per group in this course. Eight experiments have been attributed to this course and required their ethics to not copy the results and outcomes from the other groups. Therefore, engineering ethics are appreciated. The laboratory reports were assessed using sets of outcomes outlined in the laboratory rubrics report and peer evaluation. In Week 14, individual assessment was conducted (online test) to ensure students ability to recognize the methods and procedure used for testing from hydraulic and geotechnics.

Students engaged in immersive learning

During the course, students were actively engaged in reflecting their learning. Other than the eLEAP online platform, WhatsApp group and email were the mediums used to attain students' comments and facilitate their discussions. At the end of the semester, reflective learning was also evident through the online evaluation form. The evaluation was conducted to collate comments from students for the course's Continuous Quality Improvement (CQI). The criteria obtained from the students' included their reflective performance on the course learning outcomes, the facilities and delivery approach. Based on their reflections, the students did not indicate any difficulties in achieving the learning outcomes. In fact, the students commented that it was "Very helpful to understand the subject".

Impact on Students' Learning

Students were expected to discuss the possible solutions among their group members and provide a satisfactory pre-laboratory report with a brief introduction of the theories involved in real or field application. They explained the procedures using snapshots of the video provided and equipments used with additional scientific desk study as shown in Figure 3. Most of the students were able to relate the theories with the real outcomes and used the formula for laboratory analysis. Their active learning engagement was also evident in the test conducted on Week 14, at the end of the semester.

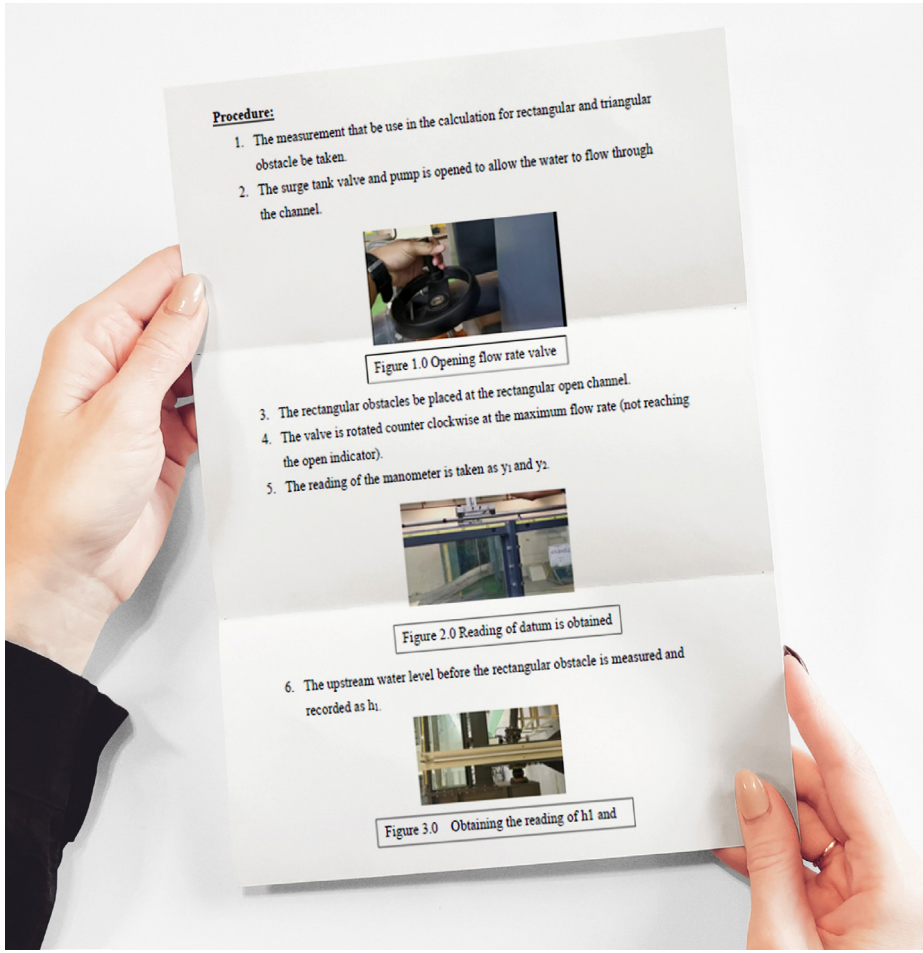
Procedure:
1. The measurement that be use in the calculation for rectangular and triangular obstacle be taken.
2. The surge tank valve and pump is opened to allow the water to flow through the channel.
Figure 1.0 Opening flow rate valve
3. The rectangular obstacles be placed at the rectangular open channel.
4. The valve is rotated counter clockwise at the maximum flow rate (not reaching the open indicator).
5. The reading of the manometer is taken as y_1 and y_2.
Figure 2.0 Reading of datum is obtained
6. The upstream water level before the rectangular obstacle is measured and recorded as h_1.
Figure 3.0 Obtaining the reading of h1 and

Diagram 9 - Example on students' laboratory report with snapshot from video demonstration

The video demonstration combined with the desk study achieved the intended outcomes of the course by introducing a new experience of laboratory experimentation through video viewing. Furthermore, the process was conducted without compromising the quality of the experience whilst providing the opportunity for observational learning experience through a digital platform. This enhanced student's knowledge comprehension and critical thinking skills while ensuring the continuation of the teaching and learning process during the COVID-19 situation.

Based on the course learning outcomes, the students should be able to conduct testing for Hydraulics and Geotechnical in the laboratory. Nonetheless, open-ended laboratory experimentation was combined with video demonstration with additional provided data.

It is believed that the transformed way of laboratory procedure reporting (through video demonstration with snapshots of procedures and brief introduction in the theories) and through scientific literature study (to provide application at field combined with data, analysis and discussion) would give similar outcomes with the physical laboratory experience. Students creatively develop their skills to comprehend and understand the real application with the help of the videos provided. Their laboratory reports were not compromised of its' quality, hence the course successfully achieved its learning outcomes. Students are engaged and motivated when being taught in a blended learning format and responded positively to the use of video recordings, video demonstrations, and online interactive e-Learning activities. These have provided an effective and creative approach to learning and teaching.

Improvement Project/Initiative in Future

Laboratory exposes students to the technical background of Engineering standard tests and enhances students' learning experience through practical and field experimentation. Students are expected to comprehend and apply the hands-on experience through standardized procedure and equipment provided in the laboratory. However, due to the COVID-19 pandemic, the laboratory subjects and the coordinators have faced difficulties in ensuring the best implementations. On the other hand, if the courses are to be deferred, there would be congestion on the number of students, availability of laboratory equipments and time constraints. Therefore, to ensure that the laboratory courses can still be conducted, the instructors initiated to provide video demonstration or virtual laboratory practice, encouraged students creative thinking by designing experiments with equipments readily found at home, inquired the submission of a video showing the practical session and presented applications of case study related to the course learning outcomes as illustrated in Figure 4. In the case study application, (eg. for hydrology

laboratory), the existing experiments consisted of investigation on the hydrology cycle and water balance indicators, which are rainfall equal to runoff, infiltration and evapotranspiration. The knowledge can be assessed through case studies on rainfall analysis, streamflow that creates runoff and etc. In summary, the instructors should be creative and explore more solutions available in the digital platform to ensure students achieve their learning outcomes.

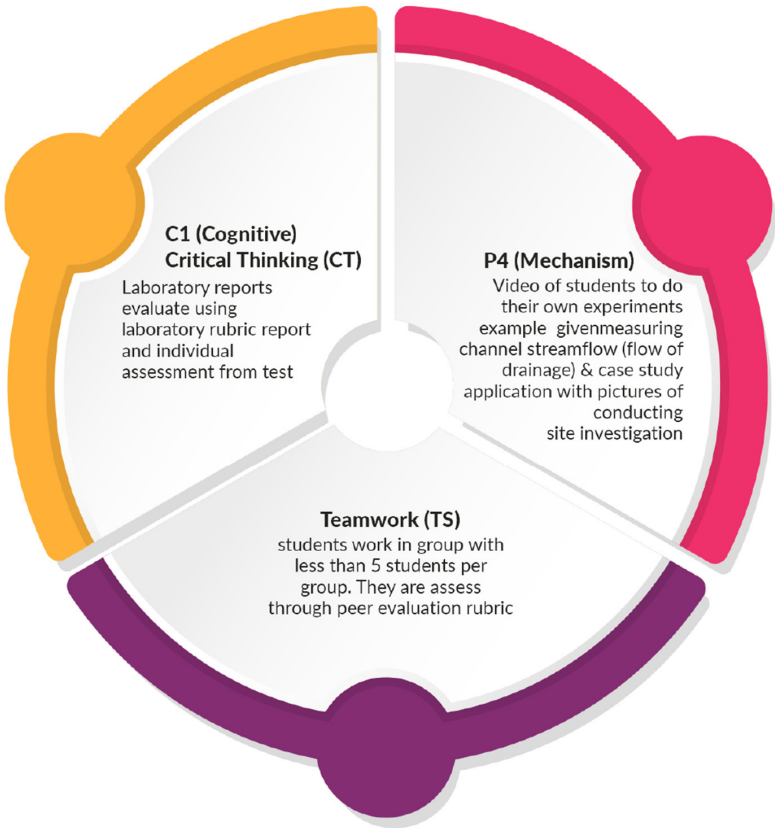

Diagram 10 Course learning outcomes, assessment and evaluation in the e-learning circumstance

Related Learning Outcome Clusters MQF 2.0

Cluster 2/3A

The course covers the psychomotor domain of P4 (Mechanism), C1 (Cognitive), and Critical Thinking (CT) and Teamwork (TS) of Soft-skills. Therefore in MQF 2.0, the course covers cluster 2 (Cognitive), and 3A (Practical skills) and 3B (Interpersonal skills).

Acknowledgement

The authors would like to thank the students for their participation on the laboratory transformation to online learning and digital platform. They would also like to thank Universiti Malaysia Sarawak for the support and infrastructure provided for the online learning environment.

Keywords

Video Demonstration, Online Learning, Open-ended laboratory, COVID-19 pandemic, digital platform, Course learning outcomes

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