Teaching, Learning and Assessments (TLA) in Civil Engineering Laboratory Courses in Open Distance Learning (ODL) during Covid-19 Pandemic

Fei Ha Chiew[1], Narita Noh[2*], Chai Lian Oh[3], Nur Asmaliza Mohd Noor[4], Che Maznah Mat Isa[5]

[1]School of Civil Engineering, College of Engineering, Universiti Teknologi MARA,
UiTM Samarahan Campus, Sarawak, Malaysia
chiewfa@uitm.edu.my
[2]School of Civil Engineering, College of Engineering, Universiti Teknologi MARA,
UiTM Pasir Gudang Campus, Johor, Malaysia
naritanoh@uitm.edu.my
[4]School of Civil Engineering, College of Engineering, Universiti Teknologi MARA,
UiTM Pahang Jengka Campus, Pahang, Malaysia
nurasmaliza@uitm.edu.my
[3 5]School of Civil Engineering, College of Engineering, Universiti Teknologi MARA
UiTM Shah Alam, Selangor, Malaysia
chailian@uitm.edu.my
chema982@uitm.edu.my
[*]Corresponding Author

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Abstract: The Covid-19 pandemic has brought about a true challenge to students and educators in the teaching, learning and assessment (TLA) of the psychomotor domain integral in laboratory experiment and design work. The pandemic has opened venues for open distance learning (ODL) with a completely new outlook for educators. The objective of this paper is to examine the suitability of the alternative TLA methods adopted in laboratory courses in ODL during the pandemic. Document review was carried out on various laboratory courses for a civil engineering programme in Universiti Teknologi MARA. The findings show that the assessment methods commonly used during ODL are individual and group reports, lab demonstration, video presentation, laboratory projects, online tests, individual online interviews, home-based mini projects, peer evaluation, and simulation using various software. Each alternative assessment was evaluated based on three (3) criteria which are the relevancy of knowledge, TLA activities, and suitability of the TLA activities to address the respective learning domain of the courses. Overall, the alternative assessment methods used during ODL were found to be relevant in imparting knowledge in laboratory courses, except for the development of specialist knowledge (WK4) as students are not able to utilize the equipment in the laboratory. Meanwhile, alternative activities are found less suitable to address the psychomotor domain imparted in the learning outcomes that involve specified equipment or machinery. Finally, the alternative assessments are found to effectively capture the cognitive skills and the programme outcomes related to knowledge application (PO1) and analysis (PO2) but are less effective in capturing investigation skills (PO4) addressing the psychomotor domain.

Keywords: Covid-19, Engineering, Laboratory, Remote Learning, Psychomotor

1. Introduction

In 2020, the outbreak of COVID-19 has brought a sudden and abrupt change in the teaching, learning, and assessment (TLA) methods in engineering laboratory courses. Engineering laboratory courses have traditionally been designed to be conducted face-to-face (F2F) in the laboratory, focusing on handling, and operating special lab equipment to attain the technical knowledge of the related topics and the respective psychomotor skills. During the pandemic, universities were forced to transform to online learning (Mathew & Chung, 2020; Sim et al., 2021; Kamil et al., 2022), and engineering laboratory courses faced big challenges when students were not able to put their hands on the materials and equipment in the laboratory. How do we conduct laboratory tasks at home? What alternative materials should be used? Do students achieve learning outcomes by conducting alternative laboratory tasks at home? Will it affect the program accreditation by the Board of Engineering Accreditation? These are the questions that arise in all universities that offer engineering courses during the shift from F2F to online learning.

This paper aims to examine the suitability of the alternative TLA methods adopted in civil engineering laboratory courses in ODL mode during the pandemic. The scope of study used in the discussion of this paper is a civil engineering degree programme (EC220) at Universiti Teknologi MARA Malaysia. The methodology section discusses the activities involved to review documents of the program and evaluate the effectiveness of the TLA implementation through ODL for laboratory courses. The findings from the document review are discussed in the results section. Lastly, an evaluation of the effectiveness of the TLA and assessment methods, particularly in achieving the learning outcomes is elaborated in the discussion section.

2. Literature Review

2.1 Outcome-based Education and requirements of Engineering Accreditation Council

Outcome-based Education (OBE) is an approach that is compulsory for accreditation of undergraduate programmes under the Engineering Accreditation Council of the Board of Engineers Malaysia. Engineering graduates are expected to attain a minimum score of the 12 Washington Accord attributes stipulated in the Engineering Programme Accreditation Standard 2020 (Board of Engineers Malaysia, 2020). On the other hand, the Malaysian Qualification Framework 2nd edition specified five (5) clusters of learning outcomes: knowledge and understanding, cognitive skills, functional work skills, personal and entrepreneur skills, and ethics and professionalism (Malaysian Qualifications Agency, 2017). At the same time, assessments of learning are categorized into three domains: cognitive (knowledge), psychomotor (movement/practical), and affective (emotion) domains. Each domain is measured at different hierarchies in different courses to ensure that engineering graduates achieve the graduate attributes upon graduation. The assessments of every course are aligned with the respective course outcomes and programme outcomes. The Programme outcomes (POs) of the EC220 programme are aligned with 12 Washington Accord Attributes to address specific learning domains, as stated in Table 1.

Table 1. Programme Outcome for EC220

Programme Outcome (PO)	Washington Accord Attributes	Learning domain
PO1	Engineering knowledge	Cognitive
PO2	Problem analysis	Cognitive
PO3	Design/development of solutions	Cognitive
PO4	Investigation	Psychomotor
PO5	Modern Tool Usage	Psychomotor
PO6	The Engineer and Society	Cognitive
PO7	Environment and sustainability	Cognitive
PO8	Ethics	Affective
PO9	Individual and teamwork	Affective
PO10	Communication	Affective
PO11	Project management and finance	Cognitive
PO12	Lifelong learning	Affective

2.2 Physical Engineering Laboratory TLA

Generally, assessments in engineering laboratory courses focus on all three (3) cognitive, psychomotor, and affective domains in enhancing students' knowledge and technical skills (Zaghloul, 2001). In a traditional engineering laboratory class, the instructor explains the theories involved and sets the instructions for the experiment before laboratory sessions. During laboratory sessions, students will conduct the experiment using equipment in the laboratory in groups, record the results and produce a report to discuss the results and theories related to the task. Though this method is effective in learning the experiments and theories involved in the course, it does not encourage students to design new solutions for an engineering problem, and thus not able to develop higher order thinking skills in designing experimental setups (Basir et al., 2018). Open Ended Laboratory (OEL) is an approach that encourages independent learning and allows students to identify suitable apparatus and design experiment procedures. In Universiti Teknologi MARA, a major shift in teaching and delivery in laboratory courses to OEL was implemented, knowing that the industry players now demand graduates to be proactive and more independent. OEL is well accepted in many Higher Learning Institutions in Malaysia including Universiti Teknologi MARA, Universiti Teknologi Malaysia and Universiti Malaysia Sabah (Mat Isa et al. 2020, Haron et al., 2013; Zaiton et al., 2012; Ali et al., 2016; Azida et al., 2018). The traditional laboratory approach is instructor-oriented, while OEL allows students to participate in completing the laboratory task according to the level of openness decided by the instructor.

Table 2 shows the Schwab/Herron Levels of Laboratory Openness used in the engineering laboratory courses. In OEL, the traditional way of conducting a laboratory where the experimental procedures are given to students is viewed as level 0. In level 0, all information is given in the laboratory manual including the objective, apparatus, and procedures of the experimental work. The higher the level of openness in OEL, the less information is given to the student. Hence, students must do preparation and literature reading before the laboratory session and the instructor will act as a facilitator to guide the students during the laboratory session.

Table 2. Schwab/Herron Levels of Laboratory Openness for OEL (McComas, 1997)

Level	Problem	Way and means	Answers
0	Given	Given	Given
1	Given	Given	Open
2	Given	Open	Open
3	Open	Open	Open

2.3 Online Engineering Laboratory TLA

Online engineering laboratory is more challenging compared to physical engineering laboratory, especially in the practical sessions that require psychomotor skills assessments (Chiew et al., 2021; Potkonjak et al., 2016). In online laboratories, students are not physically present in the laboratory to handle the equipment. During the Covid-19 pandemic, the guiding principles for teaching-learning and assessment (TLA) implementation were provided by the Board of Engineers Malaysia. The guidelines are to assist universities in conducting the Engineering Accreditation Council Malaysia (EAC) accredited programmes in maintaining education quality standards to ensure compliance with the EAC Standards 2020. The guidelines allow "other possible modes for consideration via videos of the actual demonstration of experiments by instructors either synchronously or asynchronously in such that students can access the videos to observe the experiments and subsequently utilise the experimental data to carry out the required analysis to produce a final laboratory report or presentation for assessment" (Board of Engineers Malaysia, 2021). The guidelines recommended the implementation of e-lab or simulation-based laboratory experiments during the pandemic. Thus, it can be observed that several approaches are taken as alternatives to replace physical psychomotor domain assessments in online laboratories. One of the approaches is creating a virtual laboratory, where students can explore the laboratory experiments online without stepping into a physical laboratory (Aldi, 2020). Virtual laboratories allow students to experience the real laboratory environment and equipment from the screen of their computers. Simulations of experiments are shown visually, and students can learn the concepts and theories behind the experiments by watching the videos shown. Virtual laboratories also include formative and summative assessments to evaluate students' understanding of the respective experiment and theories involved (Gamage et al., 2020).

Remote laboratories are another alternative to online laboratories and are known as e-lab. Remote laboratories allow students to access the real equipment through a web browser and software tools and this enables students to learn the related practical skills in handling the equipment (Balamuralithara and Woods, 2009; Bhute et al., 2021). However, only limited equipment comes with remote operating systems and the costs of this equipment are comparably much higher.

Another approach for online laboratories is to conduct simulations of experiments using home-based tools and materials (Aldi, 2020). During the pandemic, lecturers carefully identify tools and materials that are easily obtained at home to replace the original materials of the experiments and guide students in conducting the experiment procedures on online platforms such as google meet, Microsoft Teams, and Zoom. Students can do a video recording of how they conducted the home-based experiment, and this enables lecturers to measure students' psychomotor skills indirectly. Although students are not able to experience the original materials specified in the actual experiment, this approach does improve students' understanding of the concept involved.

3. Methodology

In this paper, an initial part of overall research to develop an effective framework for assessing the psychomotor domain is presented. This paper focuses on the investigation of the effectiveness of the current TLA implementation through ODL for civil engineering laboratory courses in the EC220 programme during the pandemic. **Fig. 1** shows the research methodology framework presented in this paper.

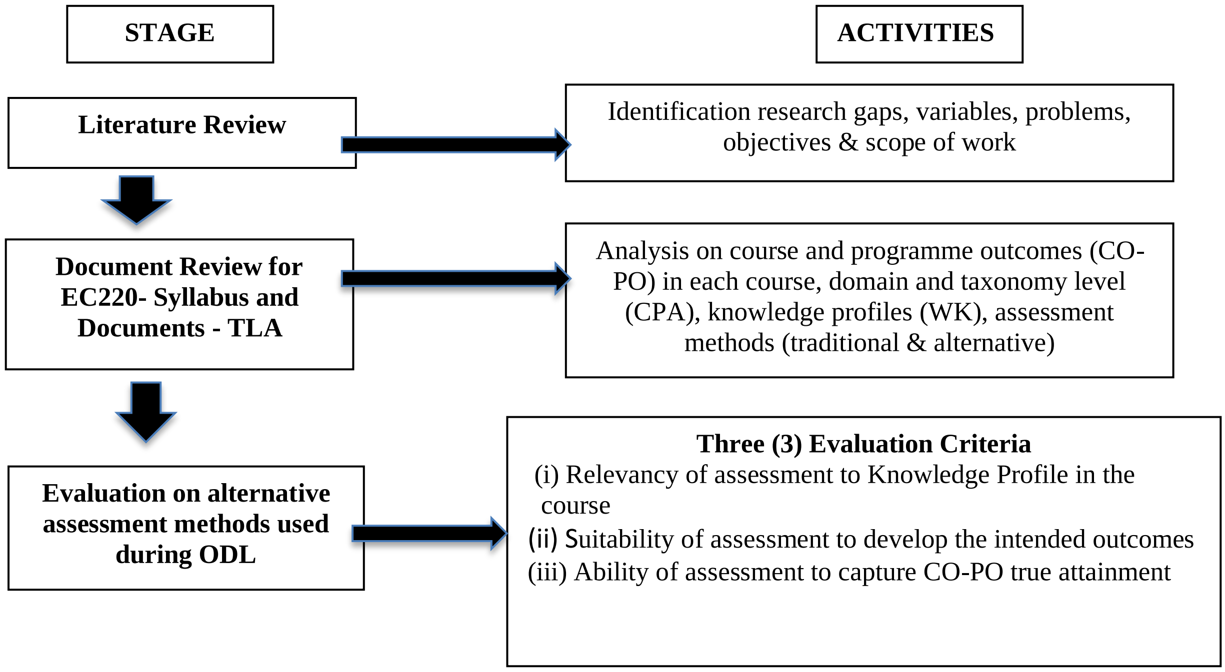

Fig. 1 Research Methodology Framework

The first stage involves gap analysis through literature review and programme's document review using a qualitative approach. The review was carried out through: (1) identification of research gaps, variables, problems, objectives, scope of work, and review of selected laboratory syllabus, (2) review of the curriculum matrix of laboratory courses against their chosen programme outcomes (PO) addressing psychomotor domain, and (3) to check if the course learning outcomes (CO) are correctly mapped to the intended POs in addressing knowledge profiles, complex engineering problems and activities (WK, WP, EA), taxonomy domain and level, assessment method and weightage, student learning time (SLT) through Course Assessment Plan (CAP).

A qualitative analysis was carried out using the following elements:

a. Course Name
b. Course and Programme Outcomes
c. Alternative Assessment used during ODL
d. Three (3) evaluation criteria are considered:
   i. Does the alternative method carry the knowledge that is relevant to the course?
   ii. Are the alternative activities suitable to develop the intended course learning outcomes?
   iii. Are the assessments capturing the Course Outcome towards true Programme Outcome attainment?

4. Results

This section presents the analysis results of the qualitative approach through documentation review. A documentation review was conducted on a total of six laboratory courses from the civil engineering programme EC220. The implementation of teaching and learning activities and assessment methods of these laboratory courses during ODL are discussed.

4.1 Teaching and Learning Activities in Laboratory Courses During ODL

Table 3 shows the addressed POs, taxonomy domains, and teaching and learning activities of six laboratory courses in the EC220 programme. Almost all the reviewed laboratory courses emphasise all three taxonomy domains, specifically cognitive (associated with PO1, PO2, PO3), psychomotor (associated with PO4), and affective domains (associated with PO9). During ODL, three common teaching methodologies were identified: online lecture, laboratory demonstration, and simulation activity. All the reviewed courses implemented online lectures and briefings using video conferencing tools such as Google Meet and Microsoft Teams to deliver theories and lessons that support the experiments. In some courses, students observed the demonstration videos provided by their lecturers on the experimental procedures and the application of tools or equipment. In the ECG422 Engineering Survey Laboratory, simulation activity on the survey techniques using google earth was observed.

Table 3. Laboratory courses and addressing POs, taxonomy, and teaching methodology

Course	Addressing POs and Taxonomy Domains	Teaching methodology		
		T1	T2	T3
ECG422 Engineering Survey Laboratory (E)	PO1 (C), PO4 (P), PO9 (A)	✓	✓	✓
ECG564 Highway and Traffic Engineering (E)	PO1 (C), PO3 (C), PO4 (P)	✓		
ECS426 Structural and Material Laboratory	PO2 (C), PO4 (P), PO9 (A)	✓		
ECG428 Geotechnical Laboratory	PO1 (C), PO4 (P), PO9 (A)	✓	✓	
ECW437 Hydraulics Laboratory	PO1 (C), PO4 (P), PO9 (A)	✓	✓	
ECW568 Environmental Engineering Lab	PO1 (C), PO4 (P), PO9 (A)	✓	✓	

Note 1: E, PO, C, P, and A denote embedded, programme outcome, cognitive, psychomotor, and affective domains.
Note 2: T1, T2, and T3 denote online lecture, laboratory demonstration, and simulation activity respectively
Note 3: PO statements:
PO1 - Apply knowledge of mathematics, natural science, engineering fundamentals, and an engineering specialisation to the solution of complex engineering problems (WK1-WK4).
PO2 - Ability to identify, formulate and analyse complex civil engineering problems in reaching substantiated conclusions using principles of mathematics, sciences, and engineering knowledge (WK1-WK4).

PO3 - Design solutions for complex civil engineering problems and design systems, components, or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental consideration (WK5).
PO4 - Conduct investigations of complex problems using research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions (WK8).
PO9 - Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings.

4.2 Assessment Methods in Laboratory Courses During ODL

Table 4 shows the assessment methods implemented during ODL in the EC220 programme. Assessments such as laboratory reports, practical tests, and tests are still implemented during ODL, although the conduct has changed from F2F to online. Interestingly, many alternative assessments such as virtual laboratory demonstrations, projects, video presentations, online interviews, and home-based laboratory demonstrations have been implemented to replace the traditional laboratory activities. Among these alternative assessments, open-ended projects are primarily used in all the reviewed EC220 laboratory courses during ODL. Additionally, the video presentation is the second preferable alternative assessment method which can be seen from the implementation in about 66.7% of the reviewed laboratory courses in EC220.

Table 4. Assessment methods in laboratory courses during ODL

Laboratory Courses	Assessments							
	A1*	A2	A3	A4	A5*	A6*	A7	A8
ECG564 Highway and Traffic Engineering (E)	✓	✓	✓		✓	✓		
ECG422 Engineering Survey Laboratory (E)	✓	✓	✓			✓	✓	
ECG428 Geotechnical Laboratory	✓		✓	✓	✓	✓	✓	
ECS426 Structural and Material Laboratory	✓		✓	✓	✓	✓		✓
ECW437 Hydraulics Laboratory	✓		✓	✓	✓	✓		
ECW568 - Environmental Engineering Laboratory	✓		✓	✓	✓	✓	✓	✓

Note: * indicate assessment is similar to traditional practice. Assessments A1(laboratory/technical report), A2(virtual laboratory demonstration), A3(project), A4(video presentation), A5(practical test), A6(online test/quiz), A7(online interview) and A8(home-based laboratory demonstration).

Table 5 shows the detailed descriptions of each assessment and its addressing POs in the reviewed laboratory courses. Projects consisting of open-ended problems were generally designed to engage the students in investigative laboratory works. Students will need to apply fundamental engineering principles and laboratory techniques for problem identification, laboratory design, analysis, and solutions. It is observed that the tasks in projects are: (1) laboratory works using online tools (i.e. Google Maps and Google Streets for road audits, Google Earth for survey works), (2) home-based laboratory works using available resources from home (i.e. slump test, fluid properties test, water purification, artificial lights operation); and (3) to propose suitable laboratory procedures for the given problems.

On the other hand, lecturers generally evaluated their students' psychomotor skills in conducting their laboratory works through online interviews and video presentations during ODL compared to direct observation in the traditional laboratory conduct. In a few laboratory courses, the students recorded the home-based laboratory for identified experiments. Bloom's Taxonomy classified seven basic skills in the psychomotor domain listed from simplest to complex: perception, set, guided response, mechanism, complex overt response, adaptation, and origination. From the online interview, the lecturers can assess students' awareness (perception) and readiness to act (set) in laboratory works for courses where the students learned only from the demonstration. When the students conduct the laboratory work in a virtual or home-based style, the students can demonstrate higher psychomotor skills through the online interview and video presentation, such as imitation (guided responses) and organise (mechanism). Nonetheless, only limited experiments are suitable to be conducted at home, and the initial curriculum objective to develop students' ability to handle the available required and advanced laboratory equipment is still not fulfilled.

Table 5. Detail descriptions of the assessments of laboratory courses during ODL

Lab Course (Knowledge Profile)	Descriptions on Assessment Content during ODL & the Addressing Programme Outcomes
ECG564 Highway and Traffic Engineering (Embedded) (WK1-4, WK5, WK8)	**Laboratory report** 10% (PO3, C) - Students carried out road safety audits using Google Maps and Google Street. Laboratory report includes the laboratory methodology, highlights the non-compliance of road safety through the procedure outlined by the Public Work Department Malaysia, and a mitigation plan proposal was expected. **Practical test** 30% (PO4, P) – Online interview. **Online tests** 60% (PO1, C), (PO3, C) - Questions on assessing students' understanding of the topics/ theories included in the syllabus using online platforms.
ECG422 Engineering Survey Laboratory (Embedded) (WK1-4, WK8)	**Demonstration** 20% (PO9, A) – The students learned from the laboratory demonstration and analysed laboratory data provided by their lecturer. **Practical test** 20% (PO1, C)(PO4, P)- Individual assessment was conducted through interviews and quizzes on student understanding of setting up of the survey instrument. **Case study project** 20% (PO1, C)- Students run a virtual survey lab by applying online tools i.e. Google Earth and fundamental survey techniques, to solve the open-ended case study project. Laboratory report contains virtual laboratory works such as setting out points for a building based on the control points observed by pre-computation and then stake the building points virtually. **Online common test** 40% (PO1, C)- Questions on assessing students' understanding of the topics/ theories included in the syllabus using online platforms.
ECG428 Geotechnical Laboratory (WK1-4, WK8)	**Laboratory report** 40% (PO1, C) (PO9, A) – Students were assessed based on the video shared on YouTube and reported about the test procedure they learned from the lab demonstration. **Practical test** 40% (PO4, P) which consists of: **i) Video presentation** (Students were assessed individually with their own created video with content on a given laboratory topic) **ii) Online interview** – conducted individually

	iii) Laboratory project - Students designed their laboratory tests for flexible pavement construction. The proposal includes the suitability of the sand material as a drainage blanket, relative compaction for the road embankment, total consolidation settlement expected at the site, and CBR values for the subgrade in the design of the flexible pavement. **Online test 20%** (PO1, C) **-** Questions on assessing students' understanding of the topics specified in the syllabus using online platforms.
ECS426 Structural and Material Laboratory (WK1-4, WK8)	**Practical test** 40% (PO2, C), (PO4, P) **-** Students conducted a home-based laboratory. In a video presentation, students demonstrated the experiment slump test for two concrete mixtures, with the given mix proportion and water/cement ratio using a plastic cup. Students also need to answer several online questions related to the experiment. **Online test** 20% (PO2, C) - Questions on assessing students' understanding of the topics specified in the syllabus using online platforms. **Technical Report** 40% (PO9, A) – A mini-project was assigned. The students designed the concrete mix using the Concrete Mix Design technique and proposed laboratory procedures for testing concrete strength that adequately serves the construction industry.
ECW437 Hydraulics Laboratory (WK1-4, WK8)	**Laboratory Report** 40% (PO4, P), (PO9, A) – The students learned from the laboratory demonstration and analysed laboratory data provided by their lecturer. **Practical Test** 40% (PO4, P) **-** Students proposed suitable procedures to determine the properties of the fluid. They carried out the experiment at home and reported the laboratory conduct and findings through video presentation and a lab report. **Online Test** 20% (PO1, C) **-** Questions on assessing students' understanding of the topics specified in the syllabus using online platforms.
ECW568 Environmental Engineering Laboratory (WK1-4, WK8)	**Lab Report** 40% (PO1, C), (PO9, A) –Students observed the conduct of experiments through a given video presentation. Supporting learning materials and laboratory procedures were given based on the different levels of openness (Level 1 to Level 3). In Levels 1 and 2, students interpreted a set of given experimental data and prepared technical reports for the experiments. For Level 3 laboratory, a Mini Project was assigned. The students prepared a technical report and video presentation on the experiment for water quality assessment based on evaluating water's physical, chemical, and biological characteristics. Students designed the experiment for three different purification systems to be carried out at home. **Practical Test** 40% (PO4, P) – In the form of interview sessions, students were required to explain laboratory experiments in detail, such as apparatus, the application of the instrument, the conduct of laboratory works, and interpretation of results in the experiments. **Online Test** 20% (PO1, C) **-** Questions on assessing students' understanding of the topics specified in the syllabus using online platforms.

Note: C, P, and A denote cognitive, psychomotor, and affective domains respectively

5. Discussion

This section discusses the suitability of the alternative assessments in the laboratory courses in meeting the three evaluation criteria. For criteria 1, the teaching and learning activities such as online lectures, online demonstrations, simulation activities, proposals, and home-based laboratories are relevant to the knowledge profiles of the course. The students are expected to demonstrate knowledge of natural science (WK1), mathematics (WK2), engineering fundamentals (WK3), and engineering design (WK5) from these activities. However, due to lacking experience in practising on laboratory equipment and in a real laboratory environment for all the courses, the development of specialist knowledge (WK4) is less effective in ODL than in traditional laboratory practices, as mentioned by Potkonjak et al. (2016) and Bhute et al. (2021). For criteria 2, the activities suitably assessed learning outcomes addressing cognitive and affective skills. Aldi (2020) indicated that online laboratory assists students' understanding and cognitive abilities in conducting laboratory work. Nevertheless, ODL activities are less suitable for learning outcomes such as conducting standard laboratory tests on soil properties (ECG428), materials and structures (ECS426); fluid mechanics and hydraulics (ECW437), pollutants (ECW568), performing standard traffic fieldwork data collection (ECG564) and using theodolite, automatic level, and other modern surveying equipment for field surveys (ECG422), as mentioned by Bhute et al. (2021). For criteria 3, the online tests effectively capture the cognitive skills and the programme outcomes related to knowledge application (PO1), analysis (PO2), and design solutions (PO3), in line with Aldi (2020). Assessments such as video presentations on home-based laboratories and open-ended projects can engage the students' investigation skills (PO4). Video presentation and report can be used to evaluate the psychomotor skills (Aldi, 2020) but is very dependent on the content delivery and presentation skills and are not as direct as the observation in the laboratory. Although laboratory report is a good tool in assessing students' function as individuals (PO9), such as interpersonal characteristics, coordination, communication, and decision-making (Bhute et al., 2021), the assessment hardly captures the contribution of all group members in a team, cooperation, and relationship with members, adaptability and conflict solving. The lecturers may get a wrong perception if the students have excellent writing skills to describe the laboratory methodology even if the students are unable to perform the laboratory work or have poor collaboration with their group members. This is in line with the previous studies (Gamage et al, 2020; Mathew and Chung, 2020), which mentioned that online laboratory limits students' interactions and ability to work in groups. This challenge can be overcome with assessments such as online interviews (used in ECG422, ECG428, and ECW568) to verify and confirm the students' psychomotor performance and involvement in the laboratory course.

6. Conclusion and Recommendations

In a nutshell, the suitability of the implementation of the alternative TLA methods during the pandemic in civil engineering laboratory courses in Universiti Teknologi MARA achieved the minimum level in addressing the learning outcomes to assess the true attainment of the designated programme outcomes. Hence, continual quality improvement (CQI) on the TLA methods is suggested to ensure that the psychomotor learning outcomes can be addressed well and accordingly. Furthermore, CQI helps the design of alternative assessment tools to achieve all learning outcomes of the courses in the upcoming assessments and thus ensures that the TLA methods fulfill the requirements of the professional bodies. This paper only focuses on the general implementation of psychomotor domains in laboratory courses without considering the best practice of evaluating psychomotor domain assessment. Therefore, further research should be carried out on best practices for evaluating psychomotor domains during online teaching. Lastly, further study is required to involve the following considerations for future improvement of alternative activities during ODL: (1) how to enhance the students' understanding or appreciation of the laboratory activities? (2) how to ensure a good judgement in making decisions during the proposal, implementation, and reporting stages? (3) how to simulate the experiment responses or reactions during ODL? and (4) how to improve students' interaction and what is their satisfaction level for the course?

7. Co-Author Contribution

Chiew Fei Ha is the main author, the presenter and has prepared the literature review and looked at the overall writeup of the whole article. Narita Noh is the corresponding author (registration, payment, submitting paper) and also prepared the literature review. Nur Asmaliza Mohd Noor wrote the conclusion and suggestion section, while Oh Chai Lian and Che Maznah Mat Isa contributed to the research methodology, data entry, analysis, discussion, and part of the conclusions.

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