Assessment on Academic Achievement based on Course and Programme Outcomes of Students in Engineering Course during the Pandemic Period

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Abstract: Tremendous changes have seen the teaching and learning shift from the conventional face-to-face approach to the non-conventional method, or also known as non-face-to-face method/approach. During the pandemic period of COVID-19 that struck in late 2019, the modes of synchronous and asynchronous were adopted in the online and offline classes. It has become a concern of the academics, university staff and parents on the effectiveness of these methods on students' academic performance and how they would excel in their studies during this challenging period. The study was conducted in one of the public universities in Malaysia. It aimed to assess students' academic performance in one of the engineering courses undertaken by Civil Engineering undergraduates based on the course and programme outcomes. A descriptive analysis was carried out on the academic performance and the course assessments mapped to the course and programme outcomes. The findings show that course and programme outcomes are a good performance indicator in assessing the course achievement. The analyses also indicate that there is a well constructive alignment between the course content, method of delivery and assessment.

Keywords: Course and Programme Outcomes, Assessments, Academic performance

Introduction

COVID-19 (C-19) pandemic that struck in late 2019 has affected almost all countries and significantly affected the existing teaching and learning (T&L) pedagogies. This pandemic has seen the implementation of drastic changes, namely in the substitution of physical to non-physical T&L classes using digital technologies. During the height of this pandemic, no conventional face-to-face T&L was conducted, and the approach has shifted to non-face-to-face online T&L.

Issues related to T&L in higher education globally in response to the pandemic highlighted by Santiago et al. (2021) are categorized into three groups; i) maintaining in-class teaching with social distancing, ii) creating hybrid models (blended learning, limitation of students in campus), and iii) moving to online instruction.

A similar problem was faced by lecturers and students in Pakistan (Rafique et al., 2021) where they were not fully personalized and successful in making decisions about their online educational activities during the C-19 pandemic, thus urged the university to implement clear policies and guidelines as well as monitor the quality of online education provided by their universities.

Meanwhile, the pandemic has changed T&L activities tremendously in Malaysia, where all public and private higher education institutions and skill training institutes were closed. The online approach was the only available method to conduct T&L during this time. However, the facility and

equipment required to implement online T&L became a big challenge nationwide, especially in East Malaysia, due to poor internet connectivity (Sia & Abbas Adamu, 2020). Similar research conducted in Malaysia on 354 pre-undergraduate students through online surveys (Kamal at el., 2020) found that the transition to online learning has positively impacted students' participation in active learning. However, it gave negative impacts on the emotional feelings such as anxiety on digital literacy and technical complexity to those students who were unfamiliar with technologies, and also affected their study time management and educational fee.

Many Institutions of Higher Learning (IHL) are concerned about the impacts of T&L during the pandemic on students' achievement, especially on program outcomes and the quality of programs offered (Liew et al., 2021). Reevaluation and reassessment of T&L implementation in the education system, especially on the contents, assessments, feedback/responses, and flexible learning, is crucial during the pandemic (Borrego & Cutler, 2010; Malmqvist, 2011; Nightingale, Carew & Fung, 2007).

Geotechnics

Geotechnics is a three-unit credit civil engineering course offered to students in Year Two Semester 4 at one of public universities in Northern Malaysia. The course has adopted the outcome-based education (OBE) since 2007 in the civil engineering studies center as part of the accreditation requirement by Engineering Accreditation Council (EAC) under the Board of Engineers Malaysia (BEM). It is to ensure that the university produces quality graduates who meet the vision and mission of the university.

Apart from it, this also guarantees the program's educational objectives, program outcomes, curriculum, and syllabus, fulfilling the accreditation body standards through the periodic audit visit.

It has two-course outcomes dealing with the roles of the geotechnical engineer in analyzing various geotechnical engineering parameters and design methods (CO1) and conceptualizing and resolving problems related to geotechnical engineering (CO2). Meanwhile, these COs are mapped to program outcomes (PO) designed by the study centers as followed by EAC (Engineering Programme Accreditation Manual, 2017) manual. There are twelve POs for the engineering program; however, the course is only mapped to two POs for intermediate degree students. The program outcomes of the Geotechnics course are Problem Analysis (PO2) and Design/Development of Solutions (PO3). By definition, for PO2, the ability to identify, formulate, research literature, and analyse complex civil engineering problems in reaching substantiated conclusions using principles of mathematics, sciences, and engineering knowledge. Meanwhile, PO3 is defined as the ability to design systems, components, or processes for solving complex civil engineering problems that meet specified needs with appropriate public health and safety and cultural, societal, and environmental considerations.

Figure 1 shows the interrelation between learning outcomes, delivery, assessments, and continuous quality improvement. It is about what the educators want the learners to know through the learning outcomes, how the educators deliver course contents and learning activities in teaching and learning, how learners learn through assessment of their performance on the course, and strategizing the best practices for future teaching and learning on how to best help students learn something. Figure 1 explains that the beginning learning outcomes of each course are mapped to POs and COs and identifying topic outcomes. The teaching and learning delivery of the course content is designed to choose the best preference approach in the current condition and situation to be taught in the classroom. Likewise, before the pandemic period, face-to-face teacher-centered learning was primarily conducted in class. The course content delivery can include slide presentations, lectures/talks/seminars, peer group discussions, and tutorial sessions. The teaching and learning activities in the classroom include doing an exercise and answering an open question given in the assignment or mini project and laboratory work. The evaluation can be recorded as mark oriented or non-mark oriented. It brings to the type of assessments in the course, either summative or formative assessment. Most summative assessments are carried out through a standard test in the middle of the semester run and a final examination at the semester's end, depending on the course design. In the OBE, it is essential to have continuous quality improvement (CQI) on past, current, and future performance of course attainment by undertaking planning, doing, checking, and acting from the course and program outcomes achievement also inclusively the course syllabus, reevaluate on

teaching and learning methods for the present and past comparison. The feedback response and exit-entrance survey are essential to evaluate the continued quality improvement in the future.

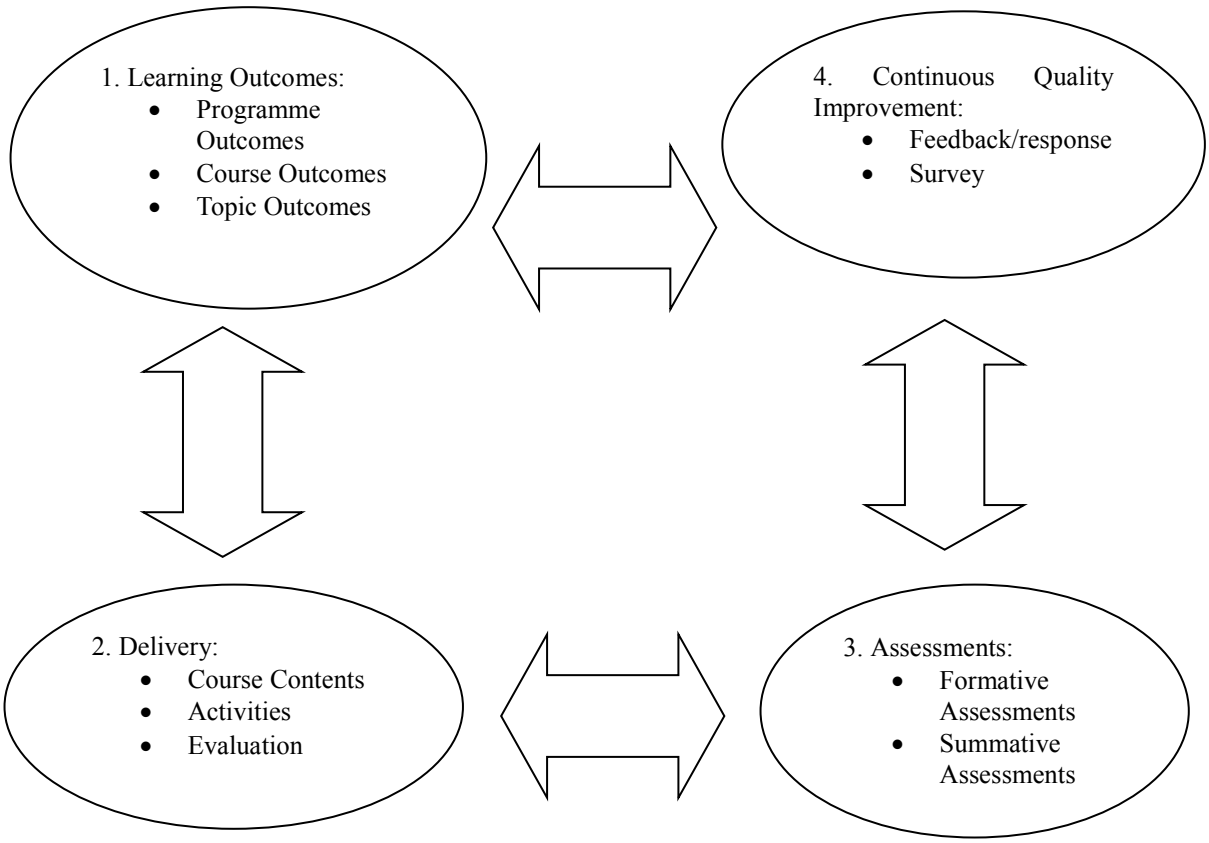

Fig. 1 A schematic illustration of constructive alignment

The study aims to assess students' academic performance in one of the engineering courses undertaken by Year Two undergraduate civil engineering degree students in Semester Four. The academic evaluation on student's performance will be based on course and programme outcomes designated in the course's assessment.

Materials and Methods

The study group consisted of 50 students in Year Two of Semester Four of session March 2020 to July 2020 who were registered in the Geotechnics course in the current semester from the civil engineering studies center. This specific group was selected for the current study since they were registered to take the course accordingly to the group's registration.

An online survey was carried out to determine basic information of the respondents such as name, student identification number, group of registration course, and location of hometown. A descriptive analysis was carried out on demographic information and academic performance of the engineering course based on course and programme outcomes designated in the course's assessments. The course's assessments are mapped with COs and POs shown in Table 1.

Table 1. Assessment types measured by topics according to the course and programme outcomes

Assessments	Topics	Course Outcome1 (CO1)	Course Outcome 2 (CO2)	Total Marks	Program Outcome 2 (PO2)	Program Outcome 3 (PO3)	Total Marks
e-Test	Topic 1 (GI)	12		30	12		30
	Topic 2 (FS)		18			18	
e-Quiz	Topic 3 (SS)	5		10	5		10
	Topic 4 (ERS)		5			5	
e-Assignment 1	Topic 1 (GI)	8		24	8		24
	Topic 3 (SS)	16			16		
e-Assignment 2	Topic 2 (FS)		12	36		12	36
	Topic 4 (ERS)		24			24	

The study was organized into four themes and sub-themes according to the research methodology shown in Table 2. The first theme describes learners' demographic information. For this theme, one sub-theme was collected by the researchers, namely gender. The second and third themes are programme outcomes (PO) and course outcomes (CO), respectively. Evaluation for CO-PO performances was done using course assessments such as tests, quizzes, and final examinations. All the responses were analyzed, tabulated, and converted to percentages. Data and variables involved in the study were analyzed using open-source software, JASP 0.14.1.0.

Table 2. Themes and sub-themes for research methodology

Themes	Sub-Themes
A. Respondent Info	
1. Demographic	1. Gender
B. Evaluation on Students Academic Performance	
2. Programme Outcomes (PO)	1. Problem Analysis (PO2) 2. Design/Development of Solutions (PO3)
3. Course Outcomes (CO)	1. Acquire various geotechnical engineering parameters and design met hods (CO1) 2. Conceptualize and resolve problems related to geotechnical engineering (CO2)
4. Evaluation Course	1. Test 2. Quiz 3. Final Examination (Assignment 1 & Assignment 2)

Result and Discussion

The results and discussions are presented based on the two major themes identified in the data analysis section: a) demographic and b) evaluation of students' academic performance based on programme and course outcomes (PO-CO), evaluation course from various assessment types and overall grading score earned by the students for Geotechnic course. The study group consisted of 50-degree students which 66% of the participants were male and about one-third of them were female (34%), as shown in Figure 2.

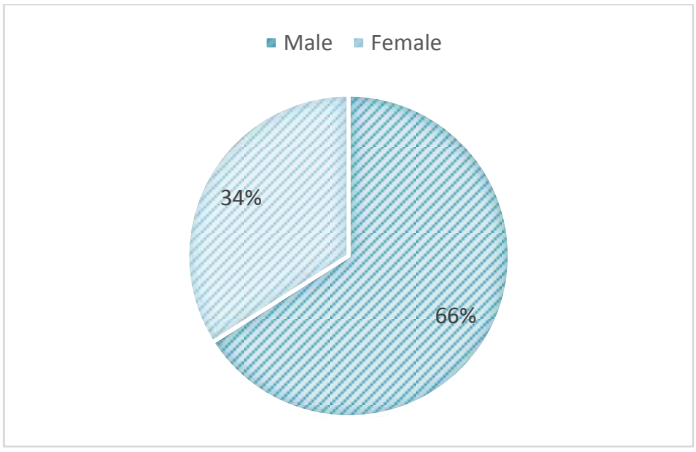

Fig. 2 Distribution on students' gender

Figure 3 shows marks distribution and average attainment of COs and POs for the Geotechnics course based on assessments from the quiz, test, and final examination designated by the university department. It shows that the CO1PO2 and CO2PO3 marks distribution percentages are 41 and 59, respectively, while the average attainments for each COPOs are 67 (CO1PO2) and 81 (CO2PO3) percent, respectively. It indicates the highest mark distribution of course assessment was measured in CO2PO3 with the highest average attainment of COPO. The T&L methodology and assessment aligned with the COs and POs mapped to meet the course outcomes on the ability to design analysis and propose a solution to geotechnical problems by adopting engineering parameters. Constructive alignment, especially in the delivery of the course contents, can be improved between the lecturer's and student's engagement in the course (El Maaddawy, Tamer & Deneen, 2017). The evaluation methods must be transparent and quality for students' benefit.

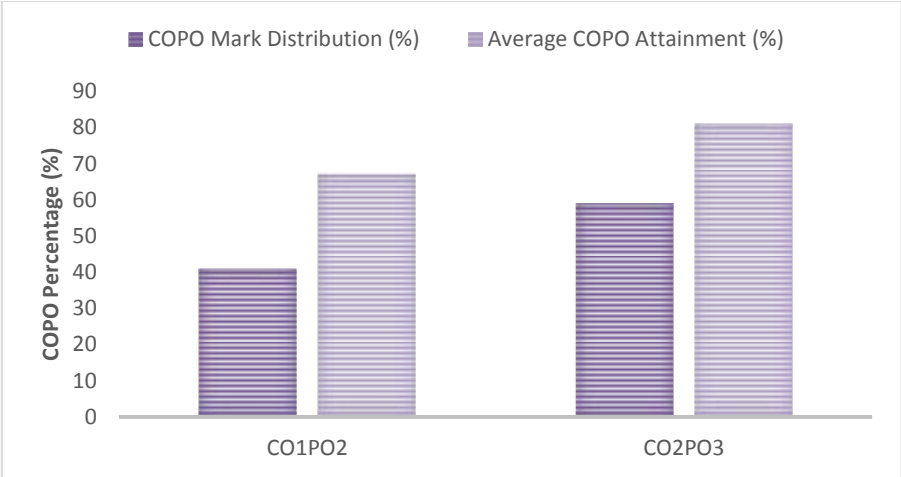

Fig. 3 COs and POs mark distribution and average attainment

Figure 4 shows CO1PO2 and CO2PO3 assessment types for the course evaluation, where CO2PO3 is the highest obtained from the test and final examination while CO1PO2 shows the highest mark in Quiz. CO1PO2 indeed asks the problem analysis with short questions and answers. However, the CO2PO3 is on designing or developing solutions that require students to answer in long sentences as well as calculation.

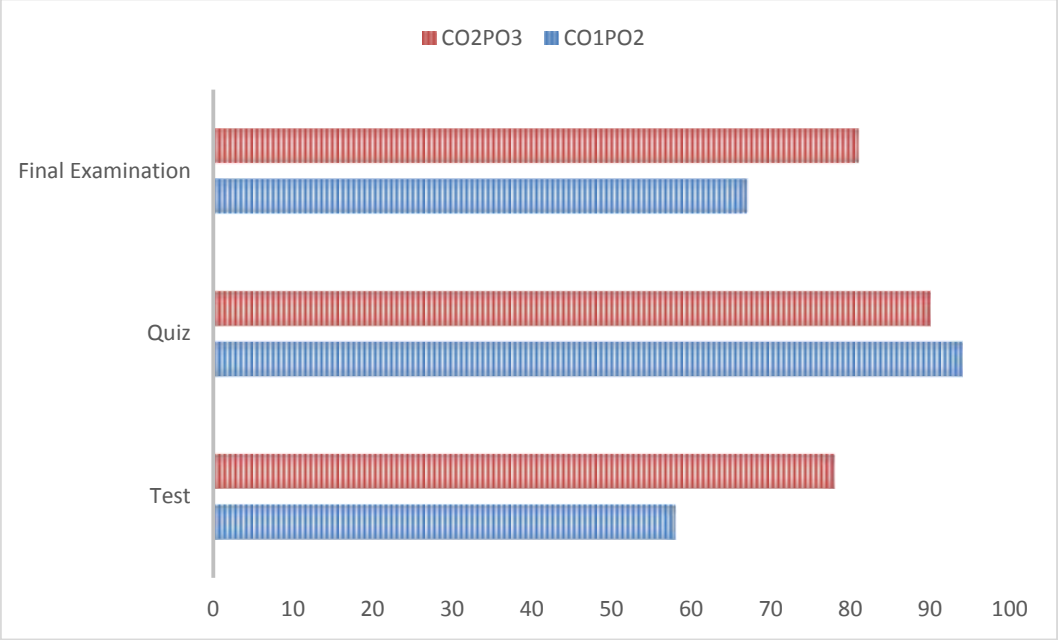

Fig. 4 Types of assessments course

Conclusion

In summary, the academic performance of students in Year Two in Semester Four of session March 2020 to July 2020 who were registered in the Geotechnics course are evaluated based on COs and POs average attainment in mark distribution designated from the course's assessments. It shows that the CO1PO2 and CO2PO3 marks distribution percentages are 41 and 59, respectively, while the average attainments for each COPOs are 67 (CO1PO2) and 81 (CO2PO3) percent, respectively. It indicates that the highest mark distribution of course assessment was measured in CO2PO3 with the highest average attainment of COPO. The COs and POs were evaluated from course assessments designated by the department. The most achievable is CO1PO2 from the quiz assessment, which is defined by problem analysis only. The CO2PO3 is the ability to design systems, components, or processes for solving complex civil engineering problems that meet specified needs with appropriate public health and safety considerations. Cultural, societal, and environmental considerations have the highest marks from test and final examination assessments. The Geotechnics course shows a well constructive alignment between the T&L content, delivery method and assessment which produce a good performance based on course and programme outcomes of students' academic in assessing the course achievement.

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Conflict of interests

The authors have no conflict of interest to declare.

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