

Assessment Programme Outcomes (POs) of the Solid Mechanics Course for an Engineering Diploma Programme

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Abstract—Most diploma programmes in Malaysia are accredited by the Engineering Accreditation Council (EAC) to ensure the quality of engineers produced by the country. POs for each programme is designed to pertain the abilities, knowledge, analytical capacity, attitude, and behaviour that students need to obtain through the course of the programme. This study focuses on the POs achievements of Solid Mechanics (ECS226), a fundamental engineering course for the Diploma in Civil Engineering (CEEC110), Centre for Civil Engineering Studies, Universiti Teknologi MARA (UiTM), Cawangan Pulau Pinang, Permatang Pauh Campus. The POs achievements were evaluated between two different academic sessions of 20202 (March – July 2020) and 20212 (March – August 2021). Based on the results, the outcome of the POs achievements between the two different sessions shows that the students' POs achievements varied on selected POs attached to this course. Through three different assessments (Quiz, Assignment and Final Assessment) which measure the PO1 and PO2 for this course, analytical trends can be identified for two different semesters. Key outcomes from this study revealed that PO1 had a relatively increasing trend while PO2 detected decreasing trends when two consecutive semesters were compared respectively. These trends were attributed from the continuous quality improvement (CQI) effectiveness of the previous semester, which led to the POs achievements in the following academic session.

Keywords—Programme Outcomes (POs), Outcome Based Education (OBE), Assessment, engineering, diploma programme.

I. INTRODUCTION

Producing professional graduates with higher quality assurance has always been a priority for the university in its mission to serve the nation, and this obligation has never changed. Universiti Teknologi MARA's system for monitoring student development has been modified as a

result of the shift from a content-driven curriculum to a learner-centered curriculum that is the current

paradigm in our education system. The new system focuses more on the essential graduate outcomes and evidence of the students' attainment of those outcomes. Since 2004, the Malaysian Higher Education Ministry and the Board of Engineers Malaysia (BEM) have implemented the Outcome-Based Education (OBE) system in an effort to work with a selected group of engineering education providers at the forefront of the field. In addition, Malaysia was accepted as a full signatory to the Sydney Accord (SA) and Dublin Accord (DA) for engineering technician programmes in 2018. OBE focuses its attention, for the most part, on three distinct learning activities for students. These are learning outcome statements, which make it clear what the student is expected to be able to know, understand, or do; and provide learning activities that will assist the student in achieving these outcomes. OBE is the most recent paradigm shift that is sweeping through the education system (Bakar et al., 2010; Deros et al., 2012; Eng et al., 2012; Jadhav et al., 2020; Katawazai, 2021; Kulkarani & Barot, 2019; Le, 2018; Mokhtar & Adnan, 2017; Mutalib et al., 2012; Naqvi et al., 2019; Ross, 2012; Yasmin & Yasmeen, 2021). This shift occurred from the traditional content-driven curriculum in the handling of teaching and learning instructions in tertiary education (Bakar et al., 2010; Eng et al., 2012; Jadhav et al., 2020; Katawazai, 2021; Kulkarani & Barot, 2019; Naqvi et al., 2019; Yasmin & Yasmeen, 2021). The goal of this shift is to produce graduates who are job ready and meet the demands of changing economic conditions. As a result, in order to guarantee that the students' accomplishments may be

evaluated in accordance with the OBE scheme, the course mapping of Programme Outcomes (POs) and Course Outcomes (COs) for each course should be established in advance (Arshad et al., 2012; Le, 2018; Naqvi et al., 2019; Osmana et al., 2012). When the diploma programme was being developed, all the POs that were allocated to each course needed to be in alignment with the PEOs that had been identified. The ECS226 course of CEEC110 was chosen for the purpose of measuring the newly enhanced performance of the POs between the most recent academic sessions of 20202 and 20212. After that, a comparison was made between both sessions in order to examine the effectiveness of CQI's implementation right after the current academic session ended.

II. COVID-19 PANDEMIC OUTBREAK

In early 2020, the coronavirus (COVID-19) which was caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) hit many countries globally. As of May 26, 2022, there were more than 524,878,064 verified COVID-19 cases and 6,283, 119 documented deaths (World Health Organization (WHO), 2022). Due to the rising number of verified cases in Malaysia, the Malaysian government issued a statewide lockdown known as the Movement Control Order (MCO) in March 2020. As a result, all Malaysian institutions of higher learning were forced to close in order to prevent the spread of COVID-19 across the country. Students, particularly those at UiTM Cawangan Pulau Pinang were required to stay at home and teaching and learning was carried out online without attending any physical classes. As a result, all coursework assessments had to be modified to fit online classrooms, and all assessments were carried out online.

III. RESEARCH METHODOLOGY

For the purpose of this study, a total number of 40 and 122 students were selected from those who had signed up for the ECS226 online classes during the academic sessions of 20202 and 20212 respectively. Due to the lack of students' intake, there is a modest variation in the number of students enrolled in this subject. There was no intake of CEEC110 before the academic session 20202 but the subsequent academic session (20212) witnessed an increase in enrolment, bringing the total number to 122 students.

This course was selected since it is a compulsory subject that was made available during the second semester. Students must also pass this subject in order to enroll in the basic structural analysis class during the fourth semester and the structural concrete and steel design and civil engineering design project during the fifth semester. Therefore, the subject selected is significant.

Table 1 shows 12 POs for CEEC110 which was developed by the Centre for Civil Engineering Studies, UiTM Cawangan Pulau Pinang, Permatang Pauh Campus. These POs as stated in Table 1 describe what students should have learned and be able to practise before completion of their diploma programme. The general characteristics of knowledge (cognitive), skills (psychomotor), and behaviour (affective) that students are expected to acquire over the course of a three-year engineering diploma programme are referred to as the POs. All POs fundamentally cover all the programme courses in CEEC110. However, ECS226 was

addressing only two programme outcomes, namely PO1 and PO2 respectively. In addition to POs, the COs for the course were also measured, which tallied with both PO1 and PO2 respectively. The mapping of POs and COs based on the assessments is represented in Table 2.

The quiz(10%), assignment(30%), and the final assessment(60%) which contributed to the total mark of 100% are the three primary assessments that were conducted online and analyzed for the continuous and summative evaluation during this COVID-19 pandemic. All the evaluations were further explored in this present research that was conducted online during the academic sessions of 20202 and 20212.

Table 1: POs for CEEC110

Upon graduation, students should be able to:	
PO1	Apply mathematical, natural science, engineering fundamentals, and engineering specialization knowledge to a wide range of practical procedures and practices.
PO2	Identify and analyze well-defined engineering problems reaching substantiated conclusions using codified methods of analysis specific to their field of activity.
PO3	Design solutions for well-defined technical problems and assist with the design of systems, components, or processes to meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.
PO4	Conduct investigations of well-defined problems; locate and search relevant codes and catalogues, conduct standard tests and measurements.
PO5	Apply appropriate techniques, resources, modern engineering and IT tools to well-defined engineering problems, with an awareness of the limitations.
PO6	Demonstrate knowledge of the societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to engineering technician practice and solutions to well-defined engineering problems.
PO7	Understand and evaluate the sustainability and impact of engineering technician's work in the solution of well-defined engineering problems in societal and environmental contexts.
PO8	Understand and commit to professional ethics, responsibilities and norms of technical practice.
PO9	Function effectively as an individual, and as a member in diverse technical teams.
PO10	Communicate effectively with the engineering community and society at large on well-defined engineering activities by understanding the work of others, documenting their own work, and giving and receiving clear instructions
PO11	Demonstrate knowledge and understanding of engineering management principles and apply these to one's own work, as a member or leader in a technical team and to manage projects in multidisciplinary environments
PO12	Recognize the need for, and have the ability to engage in independent updating in the context of specialized technical knowledge.

Table 2: Assessment-based Mapping of POs and COs

Programme Outcomes (POs)		Course Outcomes (COs)		Types of assessments
PO1	Apply mathematical, natural science, engineering fundamentals and engineering specialization knowledge to a wide range of practical procedures and practices.	CO1	Apply basic understanding of stresses and strains in the solid body, beam, shafts and column.	Quiz, Assignment and Final Assessment
PO2	Identify and analyze well-defined engineering problems reaching substantiated conclusions using codified methods of analysis specific to their field of activity.	CO2	Develop solutions for problems related to statically determinate beams.	

IV.

V. ACHIEVEMENTS IN RELATION TO POS

Figure 1 depicts all the average POs students attained for the 20202 academic session for all three (3) assessments (quiz, assignment, and final assessment) mentioned in the ECS226 course which contributes to the total 100%. The result shows that PO1 achievement decreased for all three components: quiz, assignment and final assessment i.e. from 87.3% to 71% and 66.7% respectively. PO2 on the other hand exhibited a modest increase of 77.5%, 79.3%, and 82.2%. Figure 2 depicts the POs accomplishment for the 20212 academic session. PO1 demonstrated a slight increase in accomplishment of 61%, 79.1%, and 78.9% respectively. In contrast, PO2 decreased somewhat from 62.5% to 57.4% and 48.8%.

Figures 3, 4, and 5 compare the PO attainment for each individual assessment separately during the academic sessions of 20202 and 20212. Figure 3 shows that both PO1 and PO2 for the quiz have decreased in percentage from 87.3% (PO1) and 77.5% (PO2) to 61% and 62.5% respectively. However, it reflects a different percentage for both POs in terms of the assignment. As indicated in Figure

4, PO1 attainment for the academic session of 20202 was 71%, compared to 79.1% for the 20212 academic session. PO2 has decreased significantly, falling from 79.3% to 57.4%. As illustrated in Figure 5, similar behaviour was displayed for the final assessment. PO1 attainment for the 20202 academic session was 66.7% compared to 78.9% for the 20212 academic session. PO2 has a decreasing trend, falling from 82.2% to 48.8%. Finally, Figure 6 depicted the overall PO achievement for all assessments. According to the graph, PO1 increased its proportion from 70% in the 20202 academic session to 77% in the 20212 academic session. However, the percentage of average PO2 attainment fell from 81% to 53% between academic years 20202 and 20212.

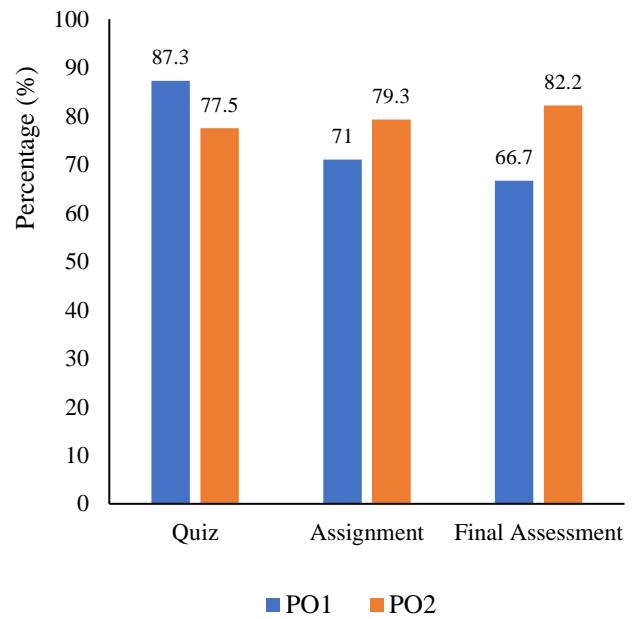


Fig. 1. Average PO attainment for the 20202 academic session

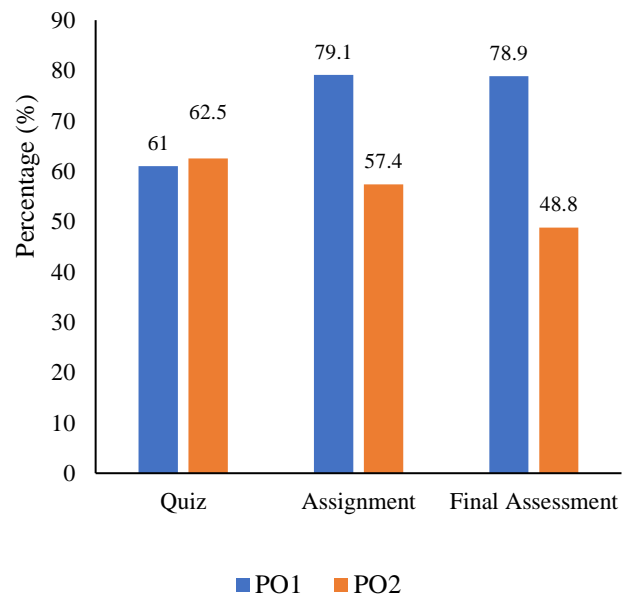


Fig. 2. Average PO attainment for the 20212 academic session

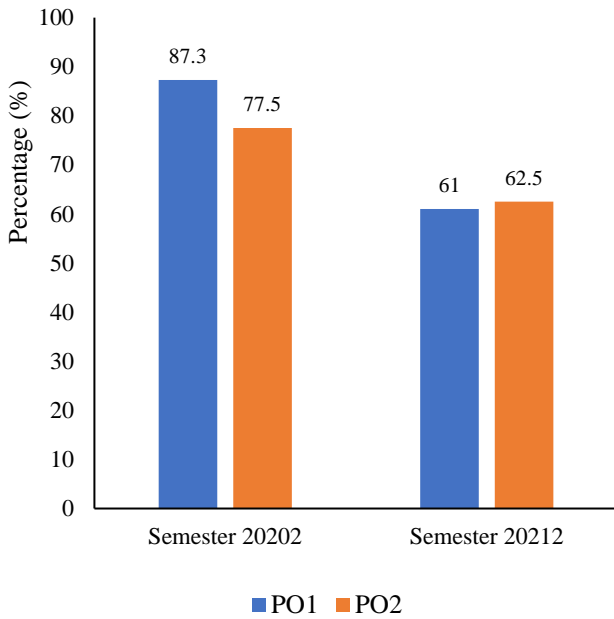


Fig. 3. Comparison of average PO attainment for quiz

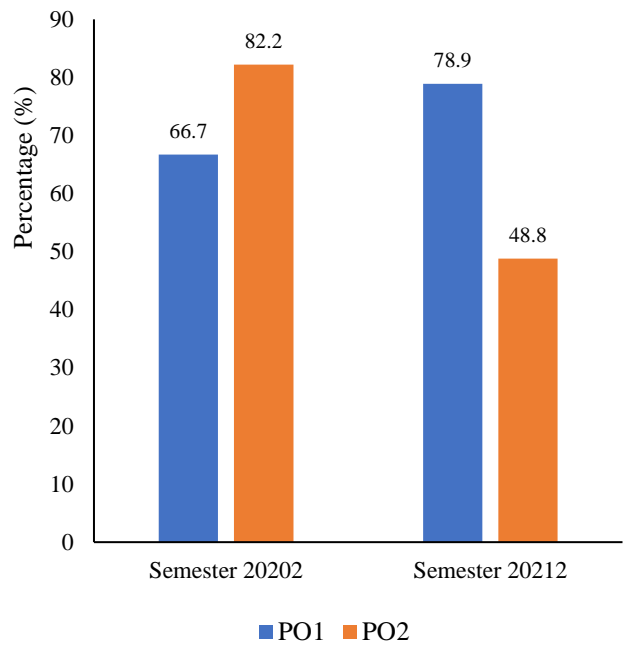


Fig. 5. Comparison of average PO attainment for final assessment

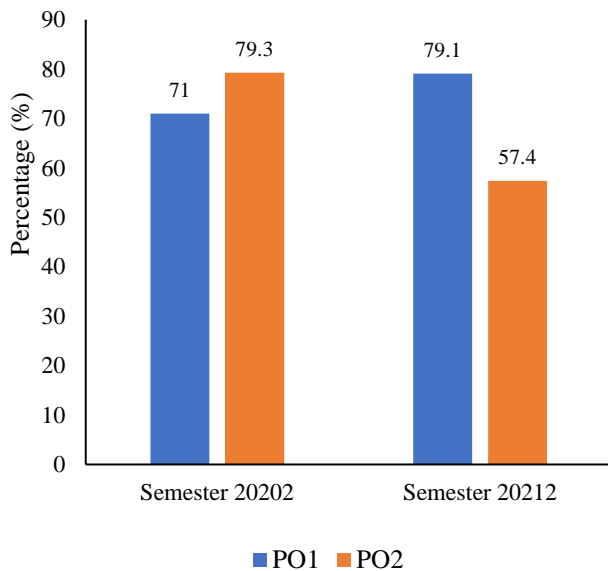


Fig. 4. Comparison of average PO attainment for assignment

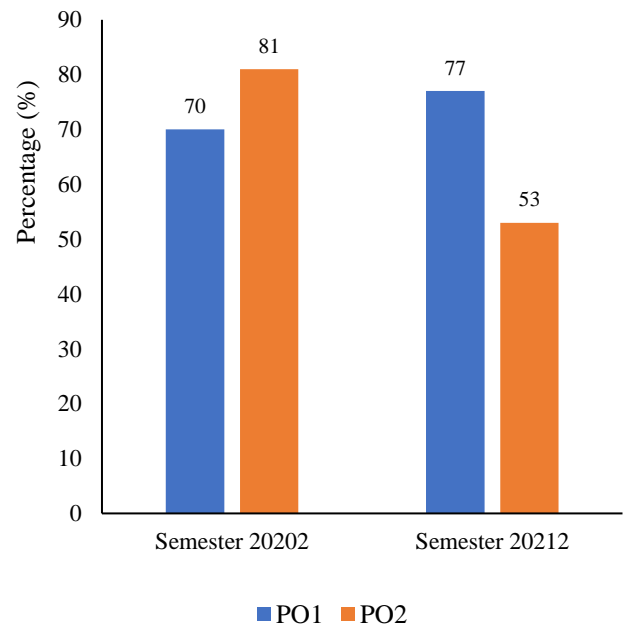


Fig. 6. Comparison on average PO attainment for all assessments(quiz, assignment and final assessment)

VI. CONCLUSION

In short, at the end of the academic session, the students demonstrated a positive outcome for the ECS226 course with more than 50% average score for both academic sessions. All assessments, with the exception of average PO2 attainment (final assessment) in academic session 20212, reflect a minimum required score of 50%. The average PO2 achievement was slightly less than 50 percent, with a score of 48.8 percent. However, the average PO attainment shows a different trend due to the vast difference between the two sessions i.e. 40 in academic session 20202 and 122 in

academic session 20212. As a result, it is critical to identify any deficiencies in each assessment for each academic session in order to improve in the following academic session and to strategize any adjustments that can be made to close the loop on continuous quality improvement (CQI).

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