

Analyzing the Impact of Programme Outcome Performance on Adjustments in Continuous Assessment Scores in Water and Wastewater Engineering Course

Nora Farina Mohd Halim*, Nurul Ain Umaiban Yusof

Faculty of Civil Engineering Universiti Teknologi Mara, UiTM Johor Pasir Gudang Branch 81750
Masai, Johor, Malaysia

*Corresponding Author

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ABSTRACT

Programme Outcomes (POs) serve as a standard for assessing the effectiveness of engineering education, particularly in outcome-based education (OBE) frameworks (Amirtharaj et al., 2022). Continuous assessment serves as a vital component of engineering education, enabling instructors to monitor student learning, provide timely feedback, and encourage consistent engagement with course materials. In courses such as Water and Wastewater Engineering, CA often includes diverse elements such as test and assignments. This study investigates the relationship between the achievement of the Programme Outcomes and the adjustments made to the Continuous Assessment (CA) scores for this course. The selected POs performance involved in this research are PO3 and PO7. PO3 represent the design and development of solutions that covers in the test and final exam while PO7 characterize the understanding and evaluating the sustainability and impact of engineering that covers in the assignment. With the adjustments of the continuous assessment scores, a quantitative study is being made to determine whether such changes make an impact in the POs performance. The findings indicate a significant change in the POs performance for both POs involved in this course. Both POs show an increment in the percentage which are for PO3 32% while for PO7 is 12%. The failure rate of students also displays a significant reduction which is from 24% to 0.5%.

Keywords: continuous assessment, outcome-based education, programme outcomes, Water and Wastewater Engineering

INTRODUCTION

Outcome-Based Education (OBE) has become a central framework in engineering education worldwide, emphasizing the achievement of predefined Programme Outcomes (POs) over traditional input-based metrics (Spady, 1994; ABET, 2022). OBE emphasis on the development of students potential and soft skills, aiming to produce graduates who possess not only a solid foundation in engineering but also knowledge of engineering technologies and practices. Moreover, OBE enhances student learning outcomes, fosters continuous quality improvement, and contributes to the sustainability of academic programs by ensuring that they remain relevant and effective (Hamsan et al., 2021; Qadir et al., 2020). As a result, graduates are better equipped to respond responsibly to changes in their surroundings, including social, environmental, and community related developments (Embi 2010; Nor et al., 2005; Heywood, 1997; Palmer et al., 2008). In Malaysia and many other countries adopting OBE, engineering programmes are rigorously evaluated based on how well students demonstrate competence across a range of POs including problem solving, design skills, communication, and ethical responsibility as outlined by bodies such as the Engineering Accreditation Council (EAC, 2020).

Within this framework, Continuous Assessment (CA) plays a pivotal role in measuring and supporting student learning throughout a course. CA typically includes assignments, quizzes, laboratory work, and other formative activities, has been recognized as an effective means of promoting active learning, diagnosing student difficulties early, and fostering consistent academic engagement (Boud & Falchikov, 2007; Yorke, 2003). In

technical fields such as civil and environmental engineering, CA is especially important as it reflects not only knowledge acquisition but also the application of complex design principles and problem-solving skills.

However, challenges arise when student performance in CAs does not align with expected PO achievement levels (David, 2025). In such cases, resource persons or programme coordinators may adjust CA scores to better reflect or meet PO attainment targets. While adjustments are sometimes justified due to external factors for examples the difficulty of assessment tasks and grading inconsistencies. Those factors may also obscure actual learning gaps if not supported by robust analysis.

This study focuses on a final year course Water and Wastewater Engineering which integrates several critical POs such as PO3 which is the design or development of Solutions and PO7 which is the environment and sustainability. These outcomes are assessed through both formative and summative methods, yet past course reviews have noted recurring discrepancies between PO attainment and raw CA scores.

The primary objective of this research aims to systematically evaluate the impact of PO performance on the CA score adjustments. Through quantitative analysis of student performance data over multiple semesters, the study aims to assess the patterns in PO performance relative to CA adjustments and determine the relationship between raw and adjusted CA scores and final exam outcomes.

METHODOLOGY

Outcome-Based Education (OBE) and Programme Outcomes (POs)

Table 1: Programme Outcomes (POs) according to Washington Accord framework

PO	PO STATEMENT
PO1	Knowledge: Apply knowledge of applied mathematics, applied science, engineering fundamentals and an engineering specialisation as specified in DK1 to DK4 respectively to wide practical procedures and practices
PO2	Problem analysis: Identify and analyse well-defined engineering problems reaching substantiated conclusions using codified methods of analysis specific to their field of activity (DK1 to DK4)
PO3	Design/development of solutions: 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 (DK5)
PO4	Investigation: Conduct investigations of well-defined problems; locate and search relevant codes and catalogues, conduct standard tests and measurements
PO5	Modern Tool Usage: Apply appropriate techniques, resources, and modern engineering and IT tools to well-defined engineering problems, with an awareness of the limitations (DK6)
PO6	The Engineer and Society: 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 (DK7)
PO7	Environment and Sustainability: Understand and evaluate the sustainability and impact of engineering technician work in the solution of well-defined engineering problems in societal and environmental contexts (DK7)
PO8	Ethics: Understand and commit to professional ethics and responsibilities and norms of technician practice; (DK7)
PO9	Individual and Teamwork: Function effectively as an individual, and as a member in diverse technical teams
PO10	Communications: Communicate effectively on well-defined engineering activities with the engineering community and with society at large, by being able to comprehend the work of others, document their own work, and give and receive clear instructions

PO11	Project Management and Finance: 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	Life Long Learning: Recognise the need for, and have the ability to engage in independent updating in the context of specialised technical knowledge

Outcome-Based Education (OBE) is an educational approach where all teaching, assessment, and curricular design focus on ensuring students achieve specific, measurable outcomes (Spady, 1994). OBE is particularly emphasized in engineering education worldwide, driven by bodies like the Washington Accord, which outlines graduate attributes to be achieved by accredited programs (Washington Accord, 2013). In Malaysia, the Engineering Accreditation Council (EAC) has adopted the Washington Accord framework, defining 12 Programme Outcomes (POs) that engineering graduates must demonstrate shown in Table 1 above.

The Role of Continuous Assessment in Engineering Education

Assessment for learning is a formative and ongoing process used during instruction to monitor students' understanding, progress, and learning needs (Sankaran & Low, 2025). Rather than focusing solely on grading or measuring final achievement, it provides information that helps teachers adjust their teaching strategies and helps students identify areas for improvement. Assessment for learning continuously tracks student progress, enabling both teachers and learners to improve their practices and achieve better learning outcomes (Morris et al., 2021).

Continuous assessment (CA) has emerged as a central pedagogical tool in modern higher education, particularly in engineering disciplines where it is used to support formative learning and enhance academic engagement. The shift from purely summative evaluation toward blended assessment systems reflects a broader educational philosophy that values continuous feedback, skill development, and authentic learning experiences (Yorke, 2003; Boud & Falchikov, 2007).

Research highlights that when properly implemented, CA enhances student motivation, provides early feedback, and helps bridge gaps in learning before high-stakes exams (Black & Wiliam, 1998). However, these benefits are contingent upon transparent grading criteria, consistency across evaluators, and alignment with learning outcomes (Rust, 2002).

Score Adjustment Practices: Necessity vs. Equity

Adjusting continuous assessment scores—whether for standardization, compensation, or moderation—is not uncommon in higher education. However, these practices often lack formal guidelines or may be applied inconsistently (Bearman et al., 2017). While moderation is essential to address discrepancies between assessors or between course components, it must be grounded in objective data and aligned with institutional policy to ensure fairness (Bloxham, Hughes, & Adie, 2016).

There is limited empirical research on the systematic analysis of CA score adjustments relative to student performance metrics such as final exam results. Some evidence suggests that instructors may subconsciously "normalize" grades to match expected distributions or to reward perceived effort rather than output (Brookhart, 2011). This can inadvertently favour certain student profiles and disadvantage others, raising ethical and pedagogical concerns.

Research Design and Data Analysis

This study employed a quantitative descriptive research design based on historical academic performance data to examine the relationship between Programme Outcome (PO) attainment and adjustments made to Continuous Assessment (CA) scores in a Water and Wastewater Engineering course. The adjustment of the CA for the course is given in the Table 2 below. This study did not employ inferential statistical procedures to determine statistical significance or hypothesis testing. Instead, the analysis focused on the direct examination

and comparison of students' raw performance data before and after the implementation of the CA adjustment.

Historical data from two consecutive academic sessions, March–July 2024 and October 2024–February 2025, were collected from students enrolled in the Diploma in Civil Engineering programme at Universiti Teknologi MARA (UiTM) Cawangan Johor Kampus Pasir Gudang. The data included students' CA scores, relevant Programme Outcome attainment, final course grades, and course failure rates. These indicators were examined to identify changes in student performance following the adjustment of the CA assessment.

No statistical significance testing or effect-size calculation was conducted because the purpose of the study was not to establish statistical generalizability or causal relationships, but rather to examine the observed performance patterns associated with the adjustment of CA scores. The findings were therefore interpreted based on the magnitude and consistency of changes observed in the raw academic performance data.

To enhance the credibility of the analysis, triangulation was employed by examining multiple sources of academic performance evidence, including CA scores, Programme Outcome attainment, final course grades, and failure rates. The convergence of evidence across these indicators was used to support the interpretation of whether the CA adjustment was consistent with students demonstrated performance and the intended Programme Outcomes.

Table 2: Course Assessment (CA) adjustment

Academic Session	March – July 2024	October 2024 – February 2025
Continuous Assessment:		
Test	30	20
Assignment	10	20

RESULT AND DISCUSSION

Programme Outcomes (POs) Performance

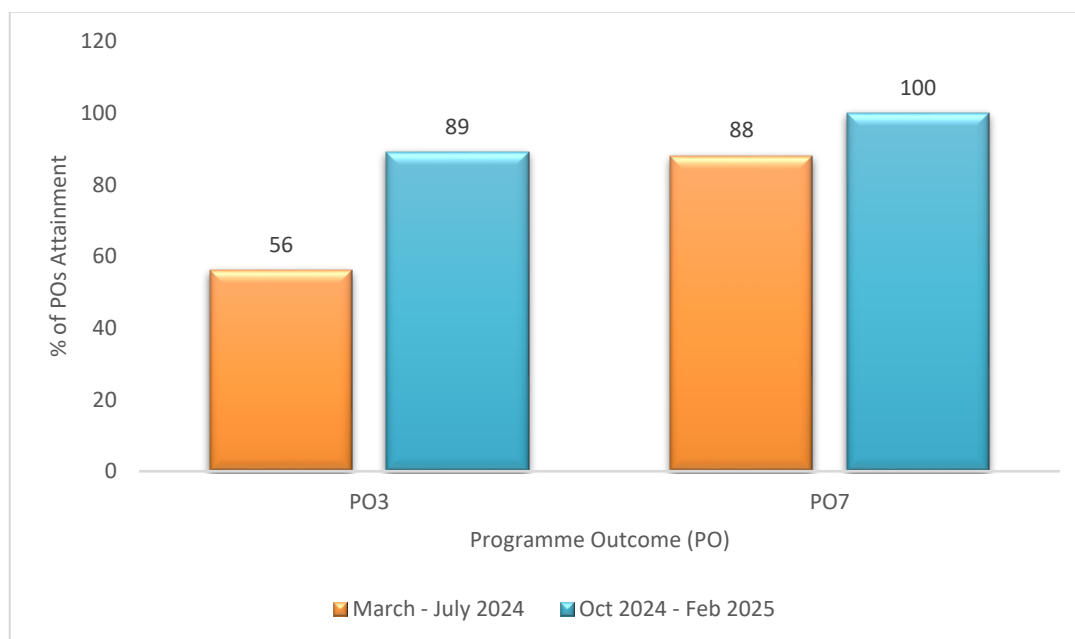


Figure 1: PO3 and PO7 Attainment by Session

The analysis of Programme Outcomes (Pos) achievement was carried out across two successive academic sessions, namely March to July 2024 and October 2024 to February 2025, focusing specifically on PO3 (Design and Development of Solutions) and PO7 (Environment and Sustainability). As shown in Figure 1, the data

reveal a marked enhancement in student attainment of both outcomes following the adjustment of the continuous assessment (CA) structure. For PO3, which primarily reflects students' ability to apply design principles and technical problem solving in assessments such as tests and final examinations, the attainment level increased significantly from 56% to 89%.

This reflects an improvement of 33% points. For PO7, which evaluates students understanding of sustainability and environmental considerations through assignments, the performance rose from 88% to a complete attainment of 100%. These improvements in PO attainment coincide with modifications made to the distribution of assessment components between the two sessions.

The test component, which is aligned with PO3, was reduced from 30% to 20%, while the assignment component, which maps to PO7, was increased from 10% to 20%. This restructured distribution appears to have allowed students to engage more effectively with both the technical and sustainability – related dimensions of the course.

The enhanced performance in PO3 suggests that a more focused and balanced test structure may have supported clearer demonstrations of design capabilities. Meanwhile, the complete attainment of PO7 indicates that the increased emphasis on assignment provided students with greater opportunity to explore, reflect upon, and articulate sustainability concepts within an engineering context. These findings align with the recent global evidences demonstrating that continuous realignment of assessment strategies with defined programme outcomes significantly enhances technical proficiency and sustainability understanding in engineering education (Pacher et al., 2024).

Failure Rate of Students

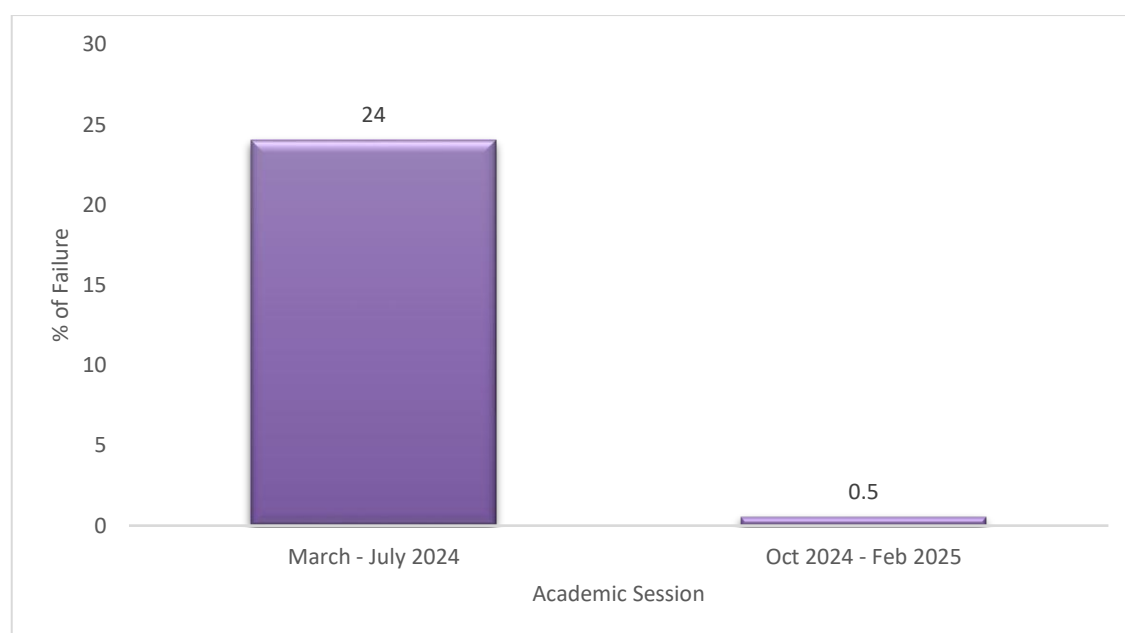


Figure 2: Students failure rates before and after CA adjustments

A comparative analysis of student failure rates across two academic sessions revealed a marked improvement following targeted adjustments in Continuous Assessment (CA) components. As shown in Figure 2, the failure rate during March to July 2024 academic session stood at 24%, signifying a concerning proportion of students unable to meet the minimum course requirements. In contrast, after refining the CA structure in the October to February session, particularly by redistributing the weighting between tests and assignments from 30:10 to 20:20, the failure rate dramatically dropped to just 0.5%. This 23.5% highlights the positive impact of aligning assessment design with intended learning outcomes.

The adjustments not only resulted in a fairer distribution of assessment tasks but also strengthened the alignment between student performance and Programme Outcomes, especially PO3 (design and development of solutions)

and PO7 (environment and sustainability). These findings align with prior studies that emphasize the importance of continuous assessment and moderation in supporting academic equity and accurately reflecting student competence (Bloxham et al., 2016; Boud et al., 2018). Furthermore, the use of assessment strategies based on empirical data supports the principle of Outcomes Based Education, which promotes measurable and transparent outcomes in engineering education (ABET 2022).

Students Final Course Grade

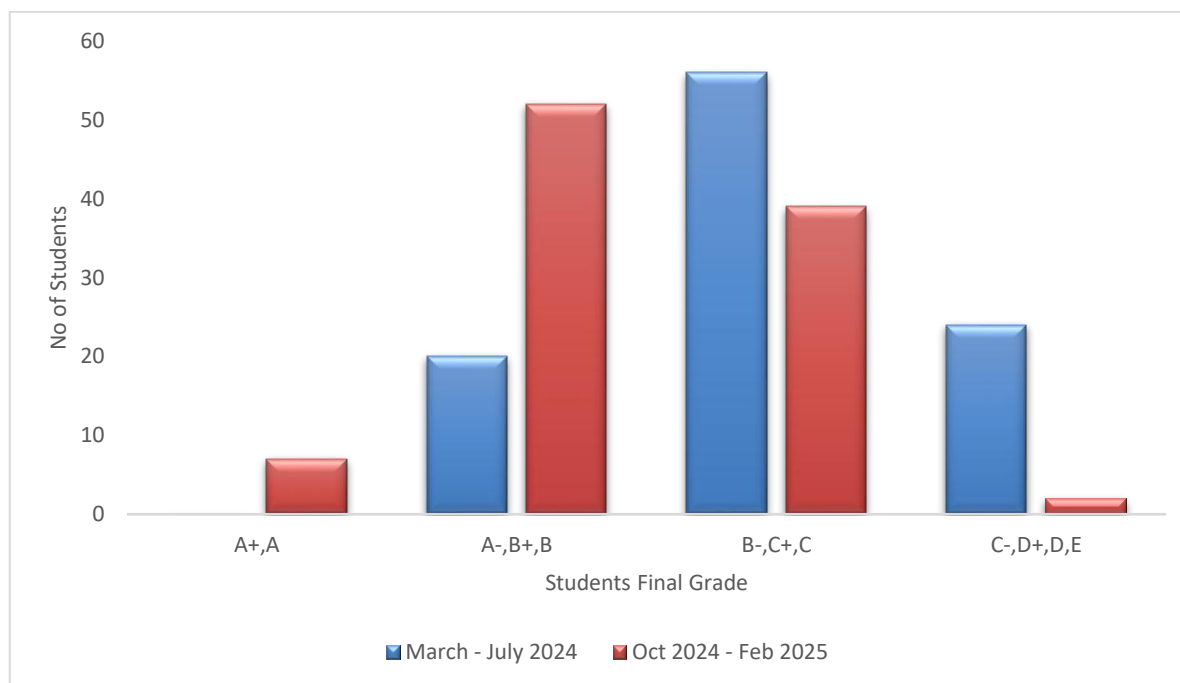


Figure 3: Distribution of student's final course grades across the two academic sessions.

The analysis of final course grades between the two academic sessions reveals a distinct shift in student performance patterns following the adjustment of Continuous Assessment (CA) components. As illustrated in Figure 3, during the March to July 2024 session, most students clustered in the B minus to C plus range, with fewer students achieving grades in the higher bands of A minus and above. Additionally, a notable number of students fell within the lower range of C minus to E, reflecting a broader distribution of weaker academic outcomes. In contrast, the October 2024 to February 2025 session exhibited a significant improvement in grade distribution. The proportion of students earning grades in the A - to B range increased substantially, while those in the C - to E range declined sharply.

This shift is supported by the data, which shows that students achieving A and A+ grades rose from 0 in the first session to nearly 10 in the second session. Similarly, those in the A- to B increased from approximately 20 students to more than 50. The C- to E group, which included about 25 students in the earlier session, dropped to fewer than 5, indicating a substantial reduction in low- performing students. The B- to C+ group also saw a moderate reduction, indicating that some of these students likely progressed to higher grade bands.

This upward shift suggests that the revised CA structure not only mitigated the failure rate but also enhanced overall academic achievement. The redistribution of assessment weighting likely contributed to more balanced evaluations, enabling students to demonstrate their competencies more effectively across diverse tasks aligned with Programme Outcomes (PO3 and PO7). These results support the view that strategic calibration of assessment design can lead to more representative and equitable academic performance (Rebecca et al., 2024).

CONCLUSION

This study has provided clear and compelling evidence that reforming the structure of Continuous Assessment contributes significantly to the achievement of educational objectives in engineering programmes (Palaposki et

al., 2024). Through the case of the Water and Wastewater Engineering course, the results demonstrate that adjusting the balance between test and assignment components led to measurable improvements in both Programme Outcome performance and overall student achievement. When the test weighting was reduced from 30% to 20% and the assignment weighting was increased from 10% to 20%, the effect on student outcomes was substantial.

Programme Outcomes three (PO3), which assesses student ability in the design and development of engineering solutions, increased in attainment from 56% to 89%, representing a gain of 33% points. Similarly, Programme Outcomes seven (PO7), which reflects student understanding of environmental impact and sustainability principles, improved from 88% to full attainment at 100%. These results show that realigning assessment weightings can empower students to better demonstrate complex skill when those assessments are aligned with their strengths and the intended outcomes. This outcome may be associated with the higher-order cognitive demands of engineering design, which require students to analyse problems, evaluate alternatives, integrate engineering knowledge, and create appropriate solutions.

In addition to these gains in outcomes performance, the data also revealed a significant improvement in overall academic standing. The failure rate dropped from 24% in the March to July session to 0.5% in the October to February session. This reduction of 23.5% reflects a major shift in student success rates. Furthermore, the distribution of final course grades showed a clear trend toward higher academic performance, with more students achieving results in the A and B categories and fewer students earning lower grades. This pattern indicates that assessment reform not only reduced failure but also elevated the academic standard across the cohort.

These findings affirm the core principles of Outcomes Based Education, which emphasize the alignment of assessment, teaching, and learning outcomes (Spady 1994, ABET 2022). They also validate the importance of continuous assessment as a tool for guiding and improving student learning when it is grounded in transparency, equity, and pedagogical (Boud et al., 2018). The improvement observed in this study reflects the growing international consensus that educational programmes must adapt assessment strategies to ensure that they support meaningful learning, promote fairness, and prepare students for real world challenges (Bloxham et al., 2016). Thus, the differing improvements in PO3 and PO7 highlight the importance of considering not only the amount of assessment allocated to an outcome, but also the cognitive level, task characteristics, and alignment between assessment activities and the specific programme outcome being measured.

In conclusion, this research highlights the importance of continuous improvement in assessment design and demonstrates the potential of using programme outcome performance as an evidence-based basis for reviewing and adjusting continuous assessment scores. When assessment strategies are informed by empirical evidence and aligned with programme outcomes, they can contribute to enhancing the quality, fairness, and effectiveness of teaching and learning (Sambell et al., 2012). The approach adopted can potentially be adapted and implemented across other engineering disciplines and courses, particularly those that are guided by outcome-based education frameworks.

The method may also be applied in different higher education institutions, subject to their respective assessment structures, programme outcomes, academic policies, and accreditation requirements. Such broader application could provide institutions with a systematic and evidence-based approach to evaluating assessment practices, identifying areas for improvement, and supporting the achievement of graduate competencies. Therefore, this approach has potential as a flexible assessment improvement strategy that can contribute to continuous quality enhancement across engineering education.

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Conflict Of Interest

The authors declare no conflicts of interest" should be included if there is no conflict of interest.

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