
The Effectiveness of Continuous Quality Improvement Implementation on the Achievement of Learning Outcomes for the DCC30093 Geotechnical Engineering

Mohd Firdaus Bin Che Soh¹, Mazlina Bt Harun²

¹ Jabatan Kejuruteraan Awam, Politeknik Sultan Mizan Zainal Abidin
E-mail: mohd.firdaus@psmza.edu.my

² Jabatan Kejuruteraan Awam, Politeknik Sultan Mizan Zainal Abidin
E-mail: mazlinaharun@psmza.edu.my

Abstract

Continuous Quality Improvement (CQI) is an approach that is gaining increasing attention in efforts to improve learning outcomes in higher education, particularly for Geotechnical Engineering courses. Geotechnical Engineering courses are one of the main courses in Civil Engineering that leads to an understanding and knowledge relates to the engineering properties of soils in civil engineering works. Based on the achievement of the Course Learning Outcome for the DCC30093 Geotechnical Engineering course, this study was conducted to evaluate the effectiveness of Continuous Quality Improvement implementation in achieving the desired learning outcomes for the Geotechnical Engineering course especially for CLO1: Apply fundamental of engineering properties of soils in civil engineering works. The objective of this study is to examine the difference in the achievement of CLO for the DCC30093 Geotechnical Engineering course for different sessions in terms of the achievement of CLO1 item. The research method used is a quantitative data analysis referred from Polytechnic Information Management System, SPMP (i-exam), Sultan Mizan Zainal Abidin Polytechnic. Data was obtained from the Course Outline Review Report issued at the end of each semester for the DCC30093 Geotechnical Engineering course. The findings of the study show that the percentage of CLO1 achievement is the lowest compared to the other three CLOs that were also assessed. The findings of CLO1 in Session I:2022/2023, showed the lowest percentage of 42.2% compared to other CLOs and recorded achievement below the target set by the department, which is to achieve at least 50.0%. The same thing happened in Session II:2022/2023 which also recorded the lowest percentage of CLO1 achievement and was still below the target of 49.0%. For Session I:2023/2024, Session II:2023/2024 and Session I:2024/2025, CLO1 achievement is increasing and has exceeded the outlined target of more than 50%. With the increase in the percentage of CLO1 achievement, this shows that Continuous Quality Improvement (CQI) must always be implemented to ensure that the percentage of achievement for CLO1 always increases or at least exceeds the percentage target set by the department, which is 50.0% and above.

Keywords : *Geotechnical Engineering, Continuous Quality Improvement, Course Learning Outcome (CLO)*

I. INTRODUCTION

In the rapidly evolving field of geotechnical engineering, equipping students with a robust understanding of theoretical principles and practical applications is paramount. The DCC30093 Geotechnical Engineering course is specifically designed to provide foundational knowledge and skill development in this specialized branch of civil engineering. However, the dynamic and interdisciplinary nature of geotechnical engineering presents challenges in ensuring that students achieve optimal learning outcomes. To address these

challenges, the implementation of Continuous Quality Improvement (CQI) methodologies has gained prominence as a systematic approach to enhancing the quality of education.

Continuous Quality Improvement, which originated in industrial and organizational contexts, emphasizes an iterative process of planning, execution, assessment, and enhancement. When applied to education, CQI fosters a culture of continuous evaluation and refinement, enabling educators to identify gaps in learning and to implement targeted strategies for improvement. By integrating CQI principles into the DCC30093

Geotechnical Engineering course, this study seeks to address key issues such as bridging the gap between theoretical knowledge and real-world application, increasing student engagement, and meeting industry standards.

Moreover, as industries and professional practices evolve, higher education institutions are under increasing pressure to align their curricula with emerging trends and requirements. By incorporating CQI practices, educators can develop adaptive strategies that not only elevate the quality of instruction but also better prepare students for the complexities of modern geotechnical engineering. This is particularly relevant in the context of Malaysia's education landscape, where fostering technical competence and innovation is critical to national development goals.

This paper explores the effectiveness of CQI implementation within the DCC30093 Geotechnical Engineering course. The findings from this research will provide valuable insights for educators, curriculum designers, and policymakers seeking to improve teaching and learning practices in technical education.

Table 1: Course Learning Outcomes for DCC30093-Geotechnical Engineering

| No | CLO | | III. RESEARCH OBJECTIVE |
|----|-------|---|--|
| 1 | CLO1C | Apply fundamental of engineering properties of soils in civil engineering works | To evaluate the effectiveness of Continuous Quality Improvement Implementation for DCC30093 Geotechnical Engineering by focusing on CLO1: Apply fundamental of engineering properties of soils in civil engineering works. CLO1 is an assessment that test the cognitive aspects of students and is assessed through tests. The assessment involves CLO1, which contributes a total percentage of 35%, of which 10% is assessed through test, while another 25% is assessed through final examination. |
| 2 | CLO2C | Analyze geotechnical engineering problem using appropriate method in determination of safety, stable earthworks and geotechnical structures | |
| 3 | CLO3C | Analyze data to reach conclusion on assigned topic of case study | |
| 4 | CLO4A | Explain verbally in formal presentation based on assign topic | |

II. PROBLEM STATEMENT

The achievement of optimal learning outcomes in technical courses such as DCC30093 Geotechnical Engineering is critical for preparing students to meet the complex demands of the geotechnical engineering profession. However, various challenges hinder the effectiveness of traditional teaching and learning approaches in such courses. These challenges include a disconnect between theoretical concepts and practical applications, insufficient alignment of course content with industry expectations, and a lack of systematic evaluation processes to identify and address gaps in student learning. As a result, students often struggle to fully grasp critical geotechnical engineering

principles, leading to suboptimal academic performance and inadequate professional preparedness.

Continuous Quality Improvement (CQI) has been proposed as a transformative approach to address these issues by fostering a culture of continuous assessment and enhancement within educational settings. While CQI has demonstrated success in industrial and organizational contexts, its implementation in technical education remains underexplored. The DCC30093 Geotechnical Engineering course offers a unique opportunity to evaluate the impact of CQI practices on bridging the gap between academic instruction and industry needs.

This research aims to address the problem by investigating the effectiveness of CQI implementation in enhancing learning outcomes for the DCC30093 Geotechnical Engineering course. By identifying barriers to effective learning and exploring CQI-driven interventions, this study seeks to provide actionable insights for optimizing teaching and learning practices in technical education.

IV. LITERATURE REVIEW

Continuous Quality Improvement (CQI) is a structured, data-driven process focused on enhancing organizational performance by systematically improving policies, practices, and outcomes. Originally developed in the healthcare and manufacturing sectors, CQI has increasingly been applied in educational settings to improve teaching and learning outcomes [1][2].

The Engineering Accreditation Council Malaysia (EAC) Programme Accreditation Standards [10] has included the assessment and evaluation of POs in the Engineering Curriculum to ensure that Continuous Quality Improvement (CQI) is carried out on a regular basis.

CQI represents a valuable tool for enhancing student achievement in geotechnical engineering education. By promoting continuous evaluation and refinement of teaching practices, CQI helps align course delivery with learning outcomes and industry expectations.

Continuous Quality Improvement (CQI) has proven to be a significant tool in enhancing educational practices, especially in the field of engineering education. According [3], CQI efforts in civil engineering courses during and after the Covid-19 pandemic showcased how systematic adjustments could maintain academic quality despite challenges brought about by unexpected disruptions. This highlights the adaptability of CQI in ensuring that learning objectives are consistently met, even in volatile environments.

Similarly, [9] underscore the importance of quality assurance frameworks in civil engineering education. Their study delves into how CQI aligns with Program Educational Objectives (PEOs), promoting an effective balance between theoretical knowledge and practical application. The integration of CQI practices not only strengthens the curriculum but also ensures students are well-prepared for the demands of the engineering industry.

The integration of student-centered learning strategies with CQI has been shown to create more effective and engaging educational environments. [11] present evidence that adapting teaching approaches based on student needs leads to improved academic and personal growth. Their findings emphasize how CQI complements these strategies by fostering continuous improvement in both teaching practices and learning outcomes.

Explored how CQI utilizes assessments to gather information on the effectiveness of educational program design and delivery. Their study highlighted that this feedback-driven approach leads to improvements, enhancing teaching and learning through systematic evaluation [12]. CQI supports evidence-based decision-making, enabling institutions to adapt to changing student needs and societal demands [5].

Similarly, [13] highlighted a case study on implementing outcomes-based education and CQI, showcasing how these practices improve teaching methodologies. Additionally, [14] proposed a comprehensive framework for outcome-based engineering education, emphasizing how analytical tools and evaluations drive ongoing educational enhancements.

In the context of geotechnical engineering education, [1] reveal that integrating real-world

scenarios and problem-solving activities through CQI can significantly improve student engagement and understanding. Furthermore, [6] points out the role of CQI in aligning course objectives with industry standards, thus preparing students for professional challenges.

Geotechnical engineering is a core component of civil engineering programs, encompassing soil mechanics, foundation design, slope stability, and site investigation. Courses in this domain often aim to develop both theoretical understanding and practical skills, including critical thinking, problem-solving, and proficiency in lab techniques.

Additionally [4] emphasize the need for more rigorous and longitudinal studies to evaluate how CQI-driven changes impact graduate preparedness and long-term competency in geotechnical engineering.

Increasing the frequency of formative assessments and feedback loops plays a critical role in guiding students throughout their learning journey and ensuring alignment with learning outcomes. Conducted a meta-analytical review of formative assessment strategies and found that these practices significantly enhance students' understanding and performance across diverse educational contexts [7]. Furthermore, [8] emphasized the importance of embedding feedback mechanisms within curriculum design to create continuous opportunities for reflection and improvement, thereby fostering deeper engagement with learning objectives.

Additionally, [15] discussed the importance of designing formative assessments that improve both teaching and learning, underscoring lessons learned from experienced educators.

V. RESEARCH METHODOLOGY

The research method used in this study is quantitative data analysis, where the raw data is obtained from the Polytechnic Information Management System -SPMP (i-exam). This data is specifically obtained from the Course Outcome Review Report (CORR) display, which can be accessed at the end of each semester immediately after the official results are released for the DCC30093-Geotechnical Engineering course.

VI. RESEARCH FINDINGS AND DISCUSSION

Based on the Course Outcome Review Report obtained from the SPMP (i-exam) system of Sultan Mizan Zainal Abidin Polytechnic, Group Attainment data as shown in the Table 2 below was successfully obtained based on five different academic sessions. The data displayed in Table 2 includes all CLOs that are assessed for this course.

Table 2: Group Attainment Achievement for DCC30093 Geotechnical Engineering Course

| SESSION | GROUP ATTAINMENT (%) | | | |
|----------------------|----------------------|-------|-------|-------|
| | CLO1C | CLO2C | CLO3C | CLO4A |
| I: 2022/2023 | 42.2 | 52.5 | 68.2 | 79.0 |
| II: 2022/2023 | 49.0 | 63.6 | 78.6 | 76.7 |
| I: 2023/2024 | 52.3 | 72.0 | 82.3 | 88.6 |
| II: 2023/2024 | 52.6 | 70.8 | 73.1 | 85.6 |
| I: 2024/2025 | 56.4 | 76.2 | 87.8 | 81.3 |

Based on the distribution of data generated from the SPMP (i-exam) system, it can be concluded that in all academic sessions studied, the percentage of achievement for CLO1 showed the lowest percentage value compared to the other three CLOs that were also evaluated. The findings of CLO1 in Session I:2022/2023, showed the lowest percentage of 42.2% compared to other CLOs and recorded achievement below the target set by the department, which is to achieve at least 50.0%. The same thing happened in Session II:2022/2023 where CLO1 also recorded the lowest percentage of CLO achievement and was still below the target of 49.0%.

For Session I:2023/2024, Session II:2023/2024 and Session I:2024/2025, CLO1's achievement is increasing and has exceeded the outlined target of more than 50%. With this increase in the CLO1 percentage achievement, it shows that Continuous Quality Improvement (CQI) must always be implemented to ensure that the percentage achievement for CLO1 always increases or at least exceeds the percentage target set by the department, which is 50.0% and above.

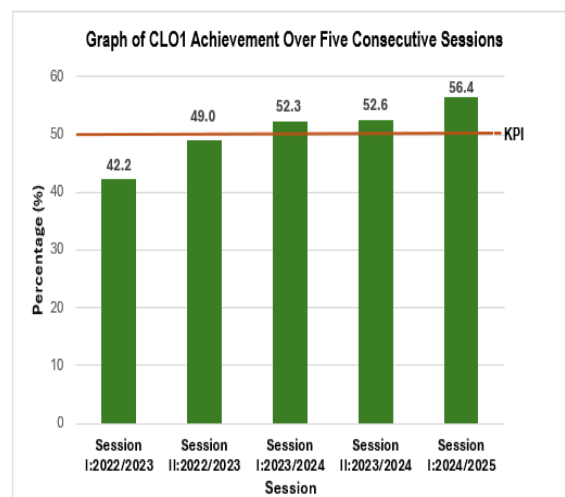


Figure 1: Graph of CLO1 Achievement Over Five Consecutive Sessions

Figure 1 above is a graph of CLO1 achievement for five consecutive. CLO1 achievement in Session I:2022/2023, was at the lowest level compared to other sessions and recorded achievement below the set target of 42.2%. The average percentage of CLO achievement for Group Achievement for a course must exceed the average percentage of learning outcome achievement set by Key Performance Indicators. However, there was an increase of 6.8% in Session II:2022/2023, with CLO1 achievement of 49.0% although still below the set target of 50%. For the next three sessions, namely Session I: 2023/2024, Session II:2023/2024 and Session I:2024/2025, CLO 1 achievement has shown positive improvement, which is increasing and exceeding the set KPI achievement target of 50%.

The percentage of CLO1 achievement for each academic session is also influenced by the number of students who fail the course and subsequently register in the following semester as repeaters. The achievement of these students will have a significant impact on Group Achievement as the students will be classified according to different sections even though there is only one student. Based on Tables 3,4,5,6 and 7, it can be observed that the CLO1 achievement for the class of repeaters is lower than the current class.

Table 3: Group Attainment Achievement for Session I:2022/2023

| SECTION | CLO1C (%) | GROUP ATTAINMENT (%) |
|--------------|-----------|----------------------|
| DKA3A | 38.0 | 42.0 |
| DKA3B | 42.0 | |
| DKA3C | 38.0 | |
| DKA3D | 45.0 | |
| DKA3E | 53.0 | |

| | | |
|-------|------|--|
| DKA4A | 37.0 | |
|-------|------|--|

Table 4: Group Attainment Achievement for Session II:2022/2023

| SECTION | CLO1C (%) | GROUP ATTAINMENT (%) |
|---------|-----------|----------------------|
| DKA3A | 57.0 | 49.0 |
| DKA3B | 59.0 | |
| DKA4A | 53.0 | |
| DKA4B | 49.0 | |
| DKA4C | 35.0 | |
| DKA4E | 49.0 | |
| DKA5A | 41.0 | |

Table 5: Group Attainment Achievement for Session I:2023/2024

| SECTION | CLO1C (%) | GROUP ATTAINMENT (%) |
|---------|-----------|----------------------|
| DKA2A | 40.0 | 52.3 |
| DKA3A | 60.0 | |
| DKA3B | 57.0 | |
| DKA3C | 48.0 | |
| DKA3D | 52.0 | |
| DKA4A | 50.0 | |
| DKA4B | 59.0 | |

Table 6: Group Attainment Achievement for Session II:2023/2024

| SECTION | CLO1C (%) | GROUP ATTAINMENT (%) |
|---------|-----------|----------------------|
| DKA3A | 57.3 | 52.6 |
| DKA4A | 38.0 | |
| DKA4B | 38.0 | |
| DKA4D | 49.0 | |

Table 7: Group Attainment Achievement for Session I:2024/2025

| SECTION | CLO1C (%) | GROUP ATTAINMENT (%) |
|---------|-----------|----------------------|
| DKA3A | 55.6 | 56.4 |
| DKA3B | 54.6 | |
| DKA3C | 61.3 | |
| DKA5A | 40.0 | |
| DKA5B | 56.0 | |
| DKA5C | 35.0 | |

VII. CONCLUSION

The implementation of Continuous Quality Improvement (CQI) has proven to be an effective strategy in improving the achievement of learning outcomes. Through systematic assessment, repeated feedback, and data-driven decision-making, CQI fosters a culture of accountability and continuous improvement in educational settings. Research findings show that institutions that adopt CQI practices show significant improvements in student performance, curriculum relevance, and teaching quality.



Furthermore, CQI encourages active stakeholder participation, enabling a more responsive and student-centered approach. While challenges such as resource constraints and resistance to change may arise, the long-term benefits of continuous CQI efforts clearly support its integration into educational quality management systems. Therefore, CQI stands out as a valuable framework for driving educational excellence and ensuring that learning outcomes are aligned with evolving academic and professional demands. Other than that, the implementation of continuous quality improvement (CQI) also has the potential to positively impact course learning outcomes, provide a better educational experience for students, and create a more effective overall learning environment.

REFERENCES

- [1] Roziah, K., Md Nor, N., & Mat Saliah, S. N. (2025). Continuous Quality Improvement for Civil Engineering Course During and After the Covid-19 Pandemic. *Jurnal Kejuruteraan*, 37(1), 507-526.
- [2] American Institutes for Research. (2021). Using Continuous Quality Improvement in Competency-Based Education Programs: A Quick Guide for Practitioners and Program Leaders.
- [3] Keria, R., Md Nor, N., & Mat Saliah, S. N. (2025). Continuous Quality Improvement for Civil Engineering Course During and After the Covid-19 Pandemic. *Jurnal Kejuruteraan*, 37(1), 507-526.
- [4] Idris, M., Shafie, M. A., & Liaw, S. C. (2023). Online OBE-CQI Tool for Engineering Programmes. *Esteem Academic Journal*, 9(1), 37-47.

- [5] Koh, Y. Y., & Chong, P. L. (2019). Incorporating Student Feedback into Curriculum Review According to Outcome-Based Education Philosophy. *Journal of Engineering Science and Technology*, 14(2), 541-556.
- [6] Che Maznah, M. I., Oh, C. L., & Liew, C. P. (2021). Effective Implementation of Complex Engineering Problems and Activities in Malaysian Engineering Curricula. *Asian Journal of University Education*, 17(4), 162-178.
- [7] Foster, H. (2022). *The Impact of Formative Assessment on Student Learning Outcomes: A Meta-Analytical Review*. Kingston University.
- [8] Irons, A., & Elkington, S. (2021). *Enhancing Learning through Formative Assessment and Feedback (2nd ed.)*.
- [9] Ahmad Kamal, N., & Che Ibrahim, C. K. I. (2025). Quality assurance in civil engineering education: insights into program educational objectives (PEOs) in Malaysia. *Quality Assurance in Education*.
- [10] EAC (2020). Engineering Programme Accreditation Standards. Petaling Jaya: Engineering Accreditation Council Malaysia.
- [11] Bhardwaj, V., Zhang, S., Tan, Y. Q., & Pandey, V. (2025). Redefining learning: Student-centered strategies for academic and personal growth. *Frontiers in Education*, 10, Article 1518602.
- [12] Ismail, N. F., & Zulkifle, F. A. (2024). CQI: Improving Teaching and Learning Through Assessment and Evaluation. *Bulletin Universiti Teknologi MARA, Negeri Sembilan*.
- [13] Koh, Y. Y., & Chong, P. L. (2021). From Outcome-Based Education (OBE) to Continual Quality Improvement (CQI): A Case Study of Teaching Mechanical Engineering at University of Newcastle, Singapore. *International Journal of Emerging Technologies in Learning (iJET)*, 16(6), 45-56.
- [14] Chuah, H. T. (2021). Outcome-Based Engineering Education and Continual Quality Improvement: A Framework for Enhancing Educational Quality. *Federation of Engineering Institutions of Asia and the Pacific*.
- [15] Van der Steen, J., van Schilt-Mol, T., van der Vleuten, C., & Joosten-ten Brinke, D. (2023). Designing Formative Assessment That Improves Teaching and Learning: Lessons from Experienced Teachers. *Journal of Formative Design in Learning*, 7, 182-194.

AUTHOR'S INFORMATION

| | |
|--|--|
| <p>First Author: Mohd Firdaus Bin Che Soh</p>  | <p>Civil Engineering Department, Politeknik Sultan Mizan Zainal Abidin, Dungun, Terengganu, Malaysia</p> <p>E-mail: mohd.firdaus@psmza.edu.my</p> |
| <p>Second Author: Mazlina Bt Harun</p>  | <p>Civil Engineering Department, Politeknik Sultan Mizan Zainal Abidin, Dungun, Terengganu, Malaysia</p> <p>E-mail: mazlinaharun@psmza.edu.my</p> |