

Examining the Underlying Factors of Low Achievement in the Geology Course (ECG253): A Data-Driven Study

Siti Nur Aishah Mohd Noor, Doris Asmani Mat Yusof*, Nor Azizah Che Azmi, Mohd Firdaus Mohd Akhbar, Roslizayati Razali, Mohamed Khatif Tawaf Mohamed Yusof, Nur Syazwani Noor Rodi, Diana Che Lat

Faculty of Civil Engineering, Universiti Teknologi MARA Johor Kampus Pasir Gudang, Bandar Seri Alam, 81750 Masai, Johor, Malaysia

*Corresponding Author

DOI: <https://doi.org/10.47772/IJRISS.2026.100701117>

Received: 09 August 2026; Accepted: 14 August 2026; Published: 22 August 2026

ABSTRACT

The attainment of program outcomes for the Geology course (ECG253) offered to the Diploma in Civil Engineering students in UiTM Pasir Gudang is evaluated. It was found that most of the students were incapable of demonstrating graduate attributes PO1 which is to apply knowledge of mathematics, natural science, engineering fundamentals and an engineering specialization to wide practical procedures and practices. Therefore, this study will investigate the underlying factors of low PO1 achievement in the Geology course among previous semester students. Analysis of the previous results shows that there was not just a gap in performance, but a deeper misalignment between course expectations and student readiness. This study also aims to find out the root causes that led to the low achievement of PO1 for this course in the previous semesters. A quantitative method was employed and a total of 300 students responded to the survey. Results of the survey indicate that most of the students perceived that they had limited time to gain a deep understanding of the course and they lacked a clear understanding of the intended learning outcomes. Majority of the students complained that the final exam questions were challenging in terms of length and effort required and they were indeed not well prepared for it. Hence, the problem of the low achievement of PO1 is feasible to be solved provided both lecturers and students make efforts in striving for the success of this course.

Keywords: Applying Knowledge; Geology Course; Outcome-Based Education; Programme Outcomes; Problem Solving

INTRODUCTION

Background of Study

Outcome-Based Education (OBE) has been adopted by the Malaysian Ministry of Higher Education as the guiding framework for all tertiary institutions. It represents a significant paradigm shift from the traditional content-based curriculum toward a more results-oriented approach in teaching and learning. Besides, Outcome-Based Education (OBE) is a pedagogical model that focuses on what students are expected to achieve at the end of an instructional period, aligning curriculum design, teaching strategies, and assessment methods with clearly defined learning outcomes (Manaff Ismail et al, 2010). The primary aim of OBE is to produce graduates who are job-ready and equipped with the necessary skills to meet the evolving demands of the economy (Aziz et al., 2005; Gurukkal, 2020). Outcome-Based Education (OBE) primarily emphasizes three core components in the student learning process. First, it focuses on clearly defined learning outcome statements, which specify the knowledge, skills, and understanding that students are expected to achieve. Second, it emphasizes learning activities that are intentionally designed to support and facilitate the attainment of these outcomes (Ahmad Zakwan et al., 2022; Yasmin & Yasmeen., 2021).

Furthermore, by applying the principles of accountability, transparency, and continuous improvement, Outcome-Based Education (OBE) aims to ensure that all students acquire the knowledge, skills, and attitudes necessary

for success in academic, professional, and real-world contexts. In Malaysia, Outcome-Based Education (OBE) was introduced into the higher education sector as a strategic effort to improve graduate quality and boost employability (Morshidi, 2010). In technical fields such as engineering, Outcome-Based Education (OBE) serves as a foundation for meeting international accreditation benchmarks, including those outlined by the Washington Accord, which prioritizes the attainment of graduate competencies over mere content delivery (Abet, 2020). These international cases highlight OBE's flexibility and significance in varied educational environments.

In the context of engineering education, Programme Outcomes (POs) refer to a set of essential attributes that engineering graduates are expected to possess by the time they complete their studies. These outcomes represent the specific knowledge, skills, and competencies that students should have acquired upon graduation (Namasivayam et al., 2013). Programme Outcomes (POs) must be continuously evaluated to ensure their effective achievement and to support ongoing curriculum enhancement. This continuous improvement process is essential for maintaining the quality and relevance of academic programmes, ensuring that graduates meet the standards and expectations established by both the department and the university (Rosli et al., 2017; Noor et al., 2024).

The transition from a content-driven to a learner-centered curriculum, in line with the current educational paradigm, has led to significant changes in Universiti Teknologi MARA's system for monitoring student development. The revised system places greater emphasis on key graduate outcomes and prioritizes the collection of evidence demonstrating students' attainment of these outcomes (Ahmad Zakwan et al., 2022). One of the key Programme Outcomes which is PO1, emphasizes the ability to apply fundamental knowledge of mathematics, science, and engineering. This outcome serves as the foundation for developing higher-order cognitive and technical skills essential in the engineering profession.

Therefore, aligned with the principles of Outcome-Based Education (OBE), the Civil Engineering diploma program at Universiti Teknologi MARA (UiTM) is designed around a clearly defined set of Programme Outcomes (POs). These outcomes serve as a foundation for curriculum planning, teaching strategies, and assessment practices. They reflect the essential competencies that students are expected to acquire upon graduation, including technical expertise, analytical thinking, effective communication, teamwork, professional ethics, and a commitment to lifelong learning (Manaff Ismail et al., 2010). Each course in the program is systematically linked to relevant POs, ensuring that classroom activities contribute directly to the overall educational goals. Through this structured alignment, the program aims to produce graduates who are not only academically competent but also capable of meeting the standards of the engineering profession and the evolving needs of industry and society.

Recent academic data and course evaluations have raised a consistent concern on students enrolled in ECG253, a core geology course for civil engineering students in Universiti Teknologi MARA (UiTM), Cawangan Johor, Kampus Pasir Gudang. This course provides foundational knowledge in geology, which is crucial for civil engineering students to understand soil behavior, rock mechanics, and other geotechnical principles. However, despite its importance, the consistently low PO1 achievement observed among students has raised concerns about the course's effectiveness in achieving its intended learning outcomes. Based on the analysis of recent academic performance data reveals a concerning trend in which a significant portion of students score below the 50% threshold in both formative and summative assessments. This underperformance directly correlates with the poor attainment of Programme Outcome 1 (PO1), which emphasizes the ability to apply fundamental knowledge in mathematics, science, and engineering.

For that reason, research is required to examine the underlying factor of low PO1 achievement in the ECG253 course. There are numerous factors that could lead to low result such as misalignment between course content and PO1, ineffective teaching and learning strategies, poor assessment design, lack of student's readiness or low student motivation. Therefore, this research paper is intended to highlight the possible underlying factors of low PO1 achievement in the ECG253 course among the civil engineering diploma program in UiTM Johor, Pasir Gudang campus (Noor et al., 2024; Khan et al., 2023).

Problem Statement

Programme Outcome 1 (PO1) is a key learning goal in the Civil Engineering diploma program at UiTM. It focuses on students' ability to apply basic knowledge in mathematics, science, and engineering. However, in Geology course ECG253 at FKA UiTM Pasir Gudang, there are a significant number of students who have consistently attained below 50% in the final examination that directly assesses PO1. This low performance raises concerns about how well the course supports students in achieving PO1. These could be factors such as modes of teaching which might not be in line with the learning needs of the students, course content mismatch with PO1, the exams could be very difficult or because of some student factors such as low motivation or failure to prepare well. To improve the performance of students, the cause and prevention of this problem need to be identified and what factors can help degrade the progress of achieve PO1 in ECG253 course (Alias et al, 2020). Therefore, the research is highly essential to evaluate student related issues like academic preparedness, motivation and study behavior which could influence their performance hence the area of improvement can be done to improve the PO1 achievement by using better course content, teaching methodologies and assessment practices.

METHODOLOGY

Geology (ECG 253) is a compulsory subject for students enrolled in the Diploma of Civil Engineering program. This subject is offered to first year students under the Faculty of Civil Engineering at Universiti Teknologi Mara (UiTM) Pasir Gudang campus. The course outcome (COs) for ECG 253 is carefully designed to ensure alignment with the Programme Outcomes (POs) of the Diploma in Civil Engineering. This alignment ensures that the knowledge, skills, and values acquired through this course effectively meet the overall educational objectives of the program. Table 2.1 and Table 2.2 elaborate the designated CO and PO.

ECG 253 is designed as an embedded course that combines both laboratory and fundamental concepts in one course. The course structure emphasizes practical tests, detailed laboratory reports and final examinations. The breakdown of the marks for each assessment is presented in Table 2.3, giving students a clear overview of how their performance in various aspects of the course contributes to their final grade. As PO1 is primarily evaluated through the final examination, its achievement marks often remain below 50% each semester.

Table 2.1: Description of Course Outcomes (CO)

CO	Description
CO1	Evaluate knowledge of various geological process and structure of the earth
CO2	Evaluate knowledge of various geological processes and structure of the earth
CO3	Justify the need of the sustainability concept of civil engineering aspects based on geologic attributes

Table 2.2: Description of Programme Outcomes (PO)

PO	Description
PO1	Apply knowledge of mathematics, natural science, engineering fundamentals and an engineering specialization to wide practical and procedures and practices.
PO2	
PO3	Conduct investigation of well define problems, locate and search relevant codes and catalogue, conduct standard tests and measurements. Understand and evaluate the sustainability and impact of engineering technician work in the solution of well-defined engineering problems in societal environment contexts.

Table 2.3: Description of Course Outcomes

No	Course Assessment	CO	PO	Percentages (%)
1	Practical Test 1	CO3	PO4	20
2	Practical Test 2	CO3	PO4	20
3	Written Report	CO2	PO7	10

4	Final Examination	CO1	PO1	50
Total				100

This paper aims to explore the reasons behind the consistently low attainment of PO1 from the students' point of view. To gain insights, a set of questionnaires was distributed to students who had previously completed the ECG 253 course. The purpose of having students as respondents is to collect and analyses the responses from students who have completed the course and gain insights into their experiences, perceptions, and suggestions for improving PO1 achievement (Mohammad et al., 2024; Namoun & Alshanqiti., 2020).

There are four (A, B, C) sections of the questionnaire and students are expected to read them all and reply. Section A elaborated on the individual interest of students in this course. This portion is intended to learn the academic situation of each student and how this could affect the learning process. In section B, the researcher investigates the impression of students about the difficulty level of the course content and the overall general level. It contains the terms on density of the syllabus, the time available to understand the content and the interest and preparation habits of the students. They also question students regarding their capacity in applying knowledge of mathematics and sciences, imagining abstract issues and solving the questions of exams in the provided period. Moreover, the section aims at gathering the views on whether the course promoted critical thinking and whether practical classes were beneficial to increase the knowledge. The effectiveness of learning resources in ECG253 and the usefulness of the learning resources as discussed in section C evaluate how exactly the teaching method was effective. It includes in its scope clarity of the lecturer explaining material, approachability, multimedia or visual teaching aids. The reading habits of students, relevance of course materials and their usefulness as well as whether the course content matched well with engineering practices in the real-world have also been mentioned in the section. It also carries out an enquiry into the hand-on learning or field experiences opportunities that are available as well as a suitability of the evaluation methods (Mohammad et al., 2024).

RESULTS AND DISCUSSION

Attainment of PO and average mark scores for ECG253 Characterization of Adsorbent

Assessment of ECG253 comprises 10% of lab report (PO4), 40% of practical test (PO7) and 50% of final exam (PO1), where in this course PO1 can only be accessed in the final exam. Table 3.1 tabulates the PO's attainment for students in the past four semesters. The analysis of student performance across four semesters (20232 to 20244) reveals a consistent pattern of the low attainment of PO1, despite relatively strong performance in the Lab Report (PO4) and Practical Test (PO7) components averaging 80.25% and 68.25% respectively. The average PO1 attainment across the semesters was only 40.75%, falling well below the commonly accepted benchmark of 50%.

A closer look at the data reveals that students generally perform better in coursework and practical assessments compared to the written final examination assessment. This situation indicates that although students have practical and procedural knowledge, they may encounter difficulties in demonstrating conceptual understanding and analytical thinking during formal assessments. Therefore, a set of questionnaires was distributed to students under ID Plan 8062 who had previously completed the ECG253 course, to investigate the reasons behind the consistently low attainment of PO1 from the students' perspective.

Table 3.1: Attainment of PO based on assignment, test and final exam

ID Plan 8062		Number of Students	Lab Report	Practical Test (100%)	Final Exam (100%)	Total PO1 (100%)
Semester						
20232	Mar 2024 – July 2023	179	86	74	38	38
20234	Oct 2023 – Feb 2024	21	74	65	49	49
20242	Mar 2024 – July 2024	100	83	73	35	35

20244	Oct 2024 – Feb 2025	22	78	61	41	41
Average			80.25	68.5	40.75	40.75

Outcomes of Questionnaires

Overall, a total of 300 respondents provided feedback, and the survey outcomes are presented in four sections (A, B, C, and D). Section A focuses on the students' personal involvement in the course. Among the respondents, 53% were male and 47% were female, with all participants enrolled under ID Plan 8062 across four consecutive semesters: 20232, 20234, 20242, and 20244. Most respondents (93%) passed the course on their first attempt, while 7% were repeating the course for the second time. Figure 1 illustrates the grade distribution for ECG253 among the respondents. Most respondents (50%) achieved grades of B+/ B/ B–, followed by 24% who scored A+/ A/ A–, and approximately 19% who obtained mid-range grades of C+/ C on their first attempt. According to the survey, most students (89%) reported spending less than four hours per week revising for this course.

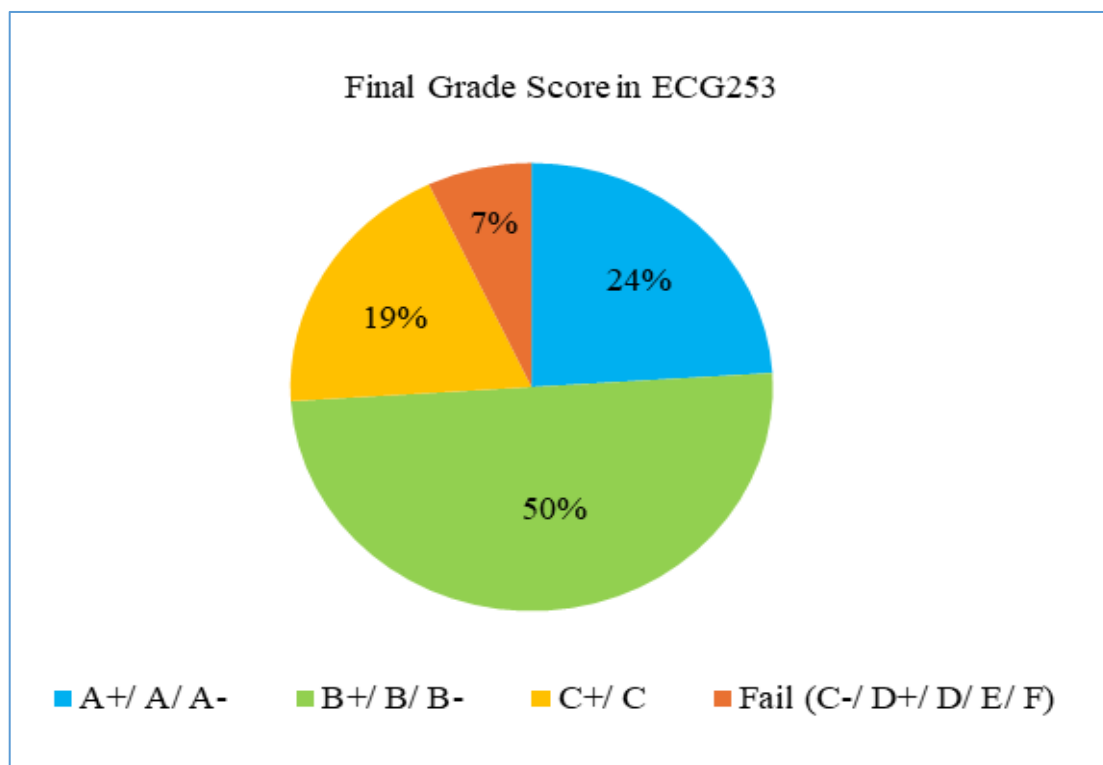


Figure 1: Respondent's grade score in ECG253

The question in section B was designed to understand the students' perception of the course content that reflects their POs' achievement in ECG253 courses. The results and analysis of Section B questions were summarized in Table 3.2. Question B9, B8, and B6 yield the highest-level perception, where the mean score was between 4.27-3.30 and ranked between numbers 1-3. The results show that students strongly agreed that the practical/laboratory sessions enhanced their understanding, as this item received the highest rating. This result indicates the significance of practical work as a valuable learning aid. This perception is reflected by a good achievement of PO4 and PO7, where both POs were assessed based on practical/laboratory activities. Conversely, most of the students agreed that the final exam had a significant effect on their performance as reflected in questions B8 and B6, where it had second and third ranking. PO1 is assessed solely based on the final exam, and the current finding significantly aligns with the lower performance of PO1 (less than 50%) as shown in Table 3.1. The student complained that the final exam questions were challenging in terms of length and effort required. However, most of the students agreed that the final exam question was designed for intellectually stimulating and beneficial for higher order thinking skills.

Question B1 and B2 yield average level perception where the mean score was between 3.27-3.08 and ranked between numbers 4-5. The results for this question showed a moderate response, indicating that the ECG253

syllabus is too heavy and students do not have sufficient time to develop a deep understanding, as reflected in responses to questions B1 and B2. Questions B3, B4, B5, and B7 yield lower-level perception where the mean score was between 2.90-2.18 and ranked between numbers 6-9. The result indicated that a limited number of students had conceptual or cognitive challenges in understanding complex content in this course, as reflected by question B5. The time given in the final exam was sufficient, as reflected by question B7, as only a minor response found that the final exam time was insufficient to answer all the final exam questions. Other than that, most of the students disagreed that they were competent in applying math and science knowledge in the ECG253 course, as reflected by Question B3. In addition, Question B4 yields the lowest average score, indicating that most of the students feel interested in learning this course.

The program and course outcomes of ECG253 indicate that students must first develop an understanding in the cognitive domain, followed by the ability to apply theoretical knowledge and concepts to analyze problems in geology. This challenge is frequently attributed to a heavily structured syllabus that encompasses an extensive topic to be addressed within a limited timeframe. ECG253 course was taken by Year 1 semester 2 students, where they were never exposed to geological engineering. Their existing knowledge was from their own reading and exposure and this course required a critical thinking skill to relate between the geology and engineering aspects. The geological knowledge of the student can be improved continuously through a combination of the psychomotor domain through laboratory activities and the cognitive domain through the theoretical part.

Analysis of the response of student perception of the ECG253 course content shows that the final exam is the main root cause that resulted in poor performance of PO1, which was subjected to the complexity and requirement of a high level of critical thinking. This result was aligned with the findings by Lee et al. (2021), where the authors found that the same factor was the main contributor to the high failure rate of the civil engineering solid mechanics course. This result indicated the need to review the degree of difficulty and complexity of final exam questions for ECG253. Other than that, the student must also plan good strategies to study and answer well in the final exam to increase PO1 attainment. Then, the effective study strategy had a significant effect on the performance of the exam for higher education levels as highlighted in Walck-Shannon et al. (2021).

Table 3.2: Student perception of the ECG253 course content

No	Items	Likert Scale (%)					Means	Rankings
		1	2	3	4	5		
B1	The syllabus is packed with too much content	2	16	45	27	10	3.27	4
B2	Students had little time to acquire a deep understanding of this course.	2	18	44	26	10	3.26	5
B3	I lacked competence in applying the knowledge of mathematics and science in this course.	10	32	39	12	7	2.73	8
B4	I had no interest in studying this course.	32	35	22	7	4	2.18	9
B5	I had difficulty visualizing the problem-solving in this course because they are often complex.	7	28	39	20	6	2.90	6
B6	Final exam questions were too lengthy and tedious.	4	15	42	26	13	3.30	3
B7	I couldn't manage to solve all the final exam questions within the given time.	12	24	34	25	5	2.88	7
B8	The course encouraged critical thinking and problem-solving skills.	1	4	32	47	16	3.75	2
B9	The practical/laboratory sessions enhanced my understanding of the subject.	0	1	15	39	45	4.27	1

The question in section C was designed to understand the students' perception of the teaching and learning experience that reflects their POs' achievement in ECG253 courses. The results and analysis of the Section C question were summarized in Table 3.3. Question C4, C3, and C2 yield the highest-level perception, where the mean score was between 4.25-4.04 and ranked between numbers 1-3. The results show that the students strongly agreed that visual aids significantly enhanced their understanding of course material, as they were the highest ranking, as reflected in Question C4. Most of the students also agreed that the lecturer's openness and willingness

to engage with questions are favorable for their understanding, as reflected by Question C3. In addition, the student strongly agreed that the lecturer successfully explained complex geological concepts clearly, as reflected in Question C2. This finding indicates effective communication of the challenging syllabus in ECG253.

Question C6, C1, and C7 yield average level perception where the mean score was between 3.97-3.92 and ranked between numbers 4-6. The results in Question C6 showed a moderate response, indicating that the teaching material provided for this course was generally effective in achieving course outcomes and results. Moreover, the students moderately agreed that the lecturer's teaching methods were helpful in their understanding of geological concepts as reflected by Question C1. The student also moderately agreed that the assessment method was appropriate to address students' performance in this course as reflected in Question C7. The result in question C7 indicates the need for reviewing and improving assessment in the ECG253 courses from the student perspective, as it yields the second lowest score and is ranked number 6. Question C5 yielded the lowest level perception, where the mean score was 3.08 and ranked number 7. This result indicates that the students did not consistently prepare in advance before attending the ECG253 classes. This lack of individual effort and preparation may have impacted on their understanding and overall performance in the ECG253 course.

Overall, the student perceptions of ECG253 teaching and learning experience were largely positive, especially regarding teaching aids and lecturer engagement. The teaching and learning experience were described by the students as effective, particularly due to the use of multimedia and interactive teaching practices. However, the lower score for student preparation suggests an area of improvement where student motivation or course structure might need enhancement for better individual preparation. A study by Liu (2022) discovered a positive linear relationship between student grade with the allocation time for study. This result indicated that when students spend a longer study time, they will achieve better academic performance.

Table 3.3: Student perception on the teaching and learning experience that reflect ECG253 performance

No	Items	Likert Scale (%)					Means	Rankings
		1	2	3	4	5		
C1	The teaching methods used in ECG253 helped me understand geological concepts.	0	2	27	46	26	3.96	5
C2	The lecturer explained complex geological concepts clearly.	0	3	20	46	31	4.05	3
C3	The lecturer was approachable and open to answering questions.	0	2	16	45	37	4.17	2
C4	The use of multimedia or visuals (e.g., diagrams, videos, maps) helped me understand the material better.	0	0	18	40	42	4.25	1
C5	I had prepared before attending ECG253 classes (e.g., reading ahead, reviewing notes).	4	20	47	21	8	3.08	7
C6	The course materials provided by lecturer were helpful in achieving the course outcomes.	0	1	26	48	25	3.97	4
C7	The method of assessments was appropriate to address students' performance in this course.	1	1	27	51	22	3.92	6

CONCLUSION AND RECOMMENDATION

This research reveals a major problem in the achievement of Programme Outcome 1 (PO1) in the Civil Engineering diploma students in ECG253 Geology course, with findings pointing to the high complexity of final exam questions and students limited preparation as key barriers. The results not only show a performance gap, but a misunderstanding in terms of course expectations and preparedness in students. The underachievement signals the urgent need for more engaging and supportive learning environments that foster critical thinking, practical application, and stronger foundational knowledge. In conclusion, it is not only about bringing the level of students up in the exam, but it also about making future engineers more confident concentrating their skills in the field they are going to real-world practice.

ACKNOWLEDGEMENT

The authors sincerely thank Universiti Teknologi MARA (UiTM) Cawangan Johor, Kampus Pasir Gudang for the support and facilities provided. Appreciation is extended to the ECG253 students for their valuable feedback, and to the Civil Engineering academic staff and coordinators for their insights and assistance in survey distribution. Special thanks to the Faculty of Civil Engineering for encouraging the enhancement of Outcome-Based Education (OBE) practices and supporting continuous quality improvement in teaching and learning.

Ethical Approval

The participation in this study was voluntary, and informed consent was obtained from all participants prior to completing the questionnaire. Participants were informed about the purpose of the study and assured that their responses would remain confidential and would be used solely for research purposes.

Conflict of Interest Statement

The authors declare that there is no conflict of interest regarding the publication of this study.

REFERENCES

1. Abet. (2020). Criteria for accrediting engineering programs. ABET Engineering Accreditation Commission.
2. Ahmad Zakwan, F. A., Ismail, R., & Endut, Mohd. Z. (2022). Assessment Programme Outcomes (POs) of the Solid Mechanics Course for an Engineering Diploma Programme. *International Journal of Practices in Teaching and Learning (IJPTL)*, 2(22).
3. Alias, R., Saim, N. M., Noor, N.A.M., & Rosli, S.H. (2020). Cognitive domain performance for non-laboratory embedded and laboratory embedded course. *International Journal of Learning, Teaching and Educational Research*, vol. 19, no. 4, pp. 206–222, 2020
4. Aziz, A., M.J., M., Megat Mohd Noor, M. J., Ali, A., & Jaafar, M. (2005). A Malaysian outcome-based engineering education model. *International Journal of Engineering and Technology*, 2.
5. Gurukkal, R. (2020). Outcome-Based Education: An Open Framework. *Higher Education for the Future*, 7, 1–4. <https://doi.org/10.1177/2347631119886402>
6. Khan, M.S.H., Salele, N., Hasan, M., & Abdou B.O. (2023). Factors affecting student readiness towards OBE implementation in engineering education: Evidence from a developing country. *Heliyon Journal*, vol 9, issue 10, 2023. Available: <https://doi.org/10.1016/j.heliyon.2023.e20905>
7. Lee, S. W., Jamal, M. H. Bin, Hasbullah, M. A. Bin, Ibrahim, M. J. B. M., Mohammad, S. N. Bin and Haron, H. A. Bin (2021) 'Forensic Investigation on The High Failure Rate of Civil Engineering Solid Mechanics Course', *Asian Journal of University Education*, 17(2), pp. 227–235.
8. Liu, M. (2022) 'The Relationship between Students' Study Time and Academic Performance and its Practical Significance', *BCP Education & Psychology*, 7, pp. 412–415.
9. Manaff Ismail, A., Ismail, R., Zakwan F. A. A., & Nizam Ismail, B. (2010). Implementation and assessment of outcome based education (OBE) in the Faculty of Civil Engineering at Universiti Teknologi MARA (UiTM). 2010 2nd International Congress on Engineering Education: Transforming
10. Mohammad, S.N., Ismail, N., Noor, M., Noh, N., Ibrahim, N. & Puaad, M.N.F.M. (2024) Performance of Students in Solid Mechanics Course and the Role of Fundamental Courses for Engineering Diploma Programme. *International Journal Of Research And Innovation In Social Science (IJRISS)*, vol VIII, issue IIIS, September 2024.
11. Morshidi, S. (2010). Strategic planning directions of Malaysia's higher education: University autonomy in the midst of political uncertainties. *Higher Education*, 59(4), 461–473.
12. Namasivayam, S., Al-Atabi, M., Chong, C. H., CHOONG, F., Fouladi, M., & Gamboa, R. (2013). A blueprint for measuring programme outcomes. *Journal of Engineering Science and Technology*, 8, 46–55.
13. Namoun and Alshanqiti, A. (2020). Predicting student performance using data mining and learning analytics techniques: A systematic literature review. *Applied Sciences*, vol. 11, no. 1, pp. 237, 2020

14. Noor, N.A.M., Muhamad, N.S., Alias, R., Rosli, S.H. (2024). Analysis of program outcomes attainment for diploma in civil engineering at Universiti Teknologi MARA Pahang. *International Journal of Evaluation and Research in Education (IJERE)*, vol. 13, no. 3, pp. 1673-1682, June 2024. ISSN: 2252-8822, Available: <https://doi.org/10.11591/ijere.v13i3.26996>.
15. Universiti Teknologi MARA. (n.d.). Diploma Program (CEEC110). Retrieved from <https://ppkapp.uitm.edu.my/diploma-civil.php>
16. Walck-Shannon, E. M., Rowell, S. F. and Frey, R. F. (2021) 'To what extent do study habits relate to performance?', *CBE Life Sciences Education*, 20(1), pp. 1–15.
17. Yasmin, M., & Yasmeen, A. (2021). Viability of outcome-based education in teaching English as second language to chemical engineering learners. *Education for Chemical Engineers*, 36, 100–106. <https://doi.org/https://doi.org/10.1016/j.ece.2021.04.005>