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# Cognitive Outcome Attainment of The Undergraduate Civil Engineering Students before and During COVID-19

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**Abstract**

This paper describes the performance of cognitive outcomes attainment of the undergraduate diploma in civil engineering students at Universiti Teknologi MARA (UiTM), Johor Branch, Pasir Gudang Campus. Specifically, this study examined the different cognitive outcomes attained among this population from before until during the implementation of the Movement Control Order (MCO) starting in the March 2020 semester. The study utilised data from the Programme Outcomes (POs) analysis by the Outcomes Based Education Committee every semester. This study identified different cognitive outcome attainments both before and during the COVID-19 semesters among students. The attainments used for the students are based on the Averaging Model, in which all courses contributing to the achievements are considered in the calculation of the cognitive outcomes average. The increase in percentages recorded from the result indicates that the shift to online learning has a useful effect on students' performances in cognitive attribution. Findings also show that some assessment grades, such as assignments, quizzes, and tests during COVID-19 semesters, can possibly improve greater achievements in cognitive level among students. The study discusses the implementation and functional descriptions of the findings and how they would be beneficial to stakeholders.

**Keywords:** Cognitive Outcome Attainment, Movement Control Order (MCO), Programme Outcomes (POs), Averaging Model, Assessment Grades.

## Introduction

The Outcome-Based Education (OBE) approach has been implemented in tertiary education both nationally and internationally to fulfil the need for assessing educational outcomes or student attainment to optimise the return on educational investment (Ortega and Cruz, 2016; Sun and Lee, 2020; Damit *et al.*, 2021). Programme Outcomes (POs) are one of the fractions in Outcomes-Based Education (OBE). According to Sankaran & Mohanty (2018), an engineering graduate must acquire graduate attributes, which describe expected

knowledge, skills, abilities, and competency during his or her engineering education. This statement was agreed upon by Alison *et al* (2021) that the rules of conduct and ethics cover competency, integrity, public interest, the environment, and the dignity of the profession and are mandatory for the registered engineer to practice. Three main domains of Bloom's Taxonomy (cognitive, affective, and psychomotor) are developed and analysed for this purpose to assess the performance of students during and after graduation.

Twelve (12) POs have been developed for the programme Diploma in Civil Engineering, Universiti Teknologi MARA (UiTM). PO1, PO2, and PO3 are classified under the cognitive domain. The cognitive domain can be defined as knowledge, depth of understanding, and critical thinking skills about a particular topic. Table 1 shows the descriptions of the cognitive POs involved in this study. This domain has been applied to monitor student learning performance and as an assessment tool. The assessment of these Programme Outcomes can be conducted through assignments, quizzes, tests, and final exams.

Table 1
*The Cognitive Programme Outcomes (POs)*

| **Programme Outcomes (POs)** | **Description** |
|---|---|
| PO1 | Apply knowledge of mathematics, natural science, engineering fundamentals and an engineering specialization to wide practical procedures and practices. |
| PO2 | Identify and analyse 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. |

Assessment is one of the most important activities in the teaching and learning process, and it is an ongoing process. It plays an important role in identifying the status of learning to provide effective learning guidance (Hwang, 2013). Arshad *et al* (2012) suggest that a study on students' attainment of programme outcomes should be done from time to time so that faculty can examine the students' level of knowledge, skills, and abilities with regard to POs so that teaching and learning aspects can be continuously enhanced.

Due to the novel coronavirus disease (COVID-19) spreading worldwide in early 2020, e-learning has become the main tool for teaching and learning. The advancement of e-learning technology expands learning possibilities beyond traditional teaching methods, whereby e-learning allows easy access to materials, flexible space, time, and pace of study, comprehensive interaction and communication, as well as immediate feedback, which are some of the benefits that make the learning process effective (Arora, 2015).

This paper describes the performance of the cognitive outcomes attainment of the undergraduate Diploma in Civil Engineering students at Universiti Teknologi MARA (UiTM), Johor Branch, Pasir Gudang Campus before and during the COVID-19 semesters. The PO attainments for individual students were evaluated based on the cumulative average model, in which all courses contributing to the achievements are considered in the calculation of the average cognitive outcomes. Therefore, this study will help to identify the difference in

student competency levels and be able to improve greater performance and achievement in cognitive skills among students.

**Methodology**

The School of Civil Engineering has developed a list of twelve (12) POs for the Diploma Programme in Civil Engineering (EC110). PO1 to PO3 refer to the general attributes of knowledge (cognitive) that students must acquire through the three years of the engineering technician diploma programme.

The sample population involved all part 1 to part 5 students from semester 20194 until 20214. These targeted students have achieved POs attainment based on their assessment marks and examination results for the fundamental, intermediate, and advanced courses before and during the pandemic COVID-19. Before COVID-19, continuous assessments such as practical tests and assignments contributed 60%, while the final examination contributed 40% to the overall marks for each course. During the outbreak of COVID-19, the assessment breakdown has changed as the method of teaching and evaluation has been shifted online. The continuous assessment during this period contributed to about 60 to 70%, while the final examination contributed about 30 to 40% of the overall marks. The final examination has been divided into two parts, which are Test 1 and Test 2. Test 1 was conducted during lecture week, while Test 2 was conducted during final exam week. The flow method for this study is shown in Figure 1 below.

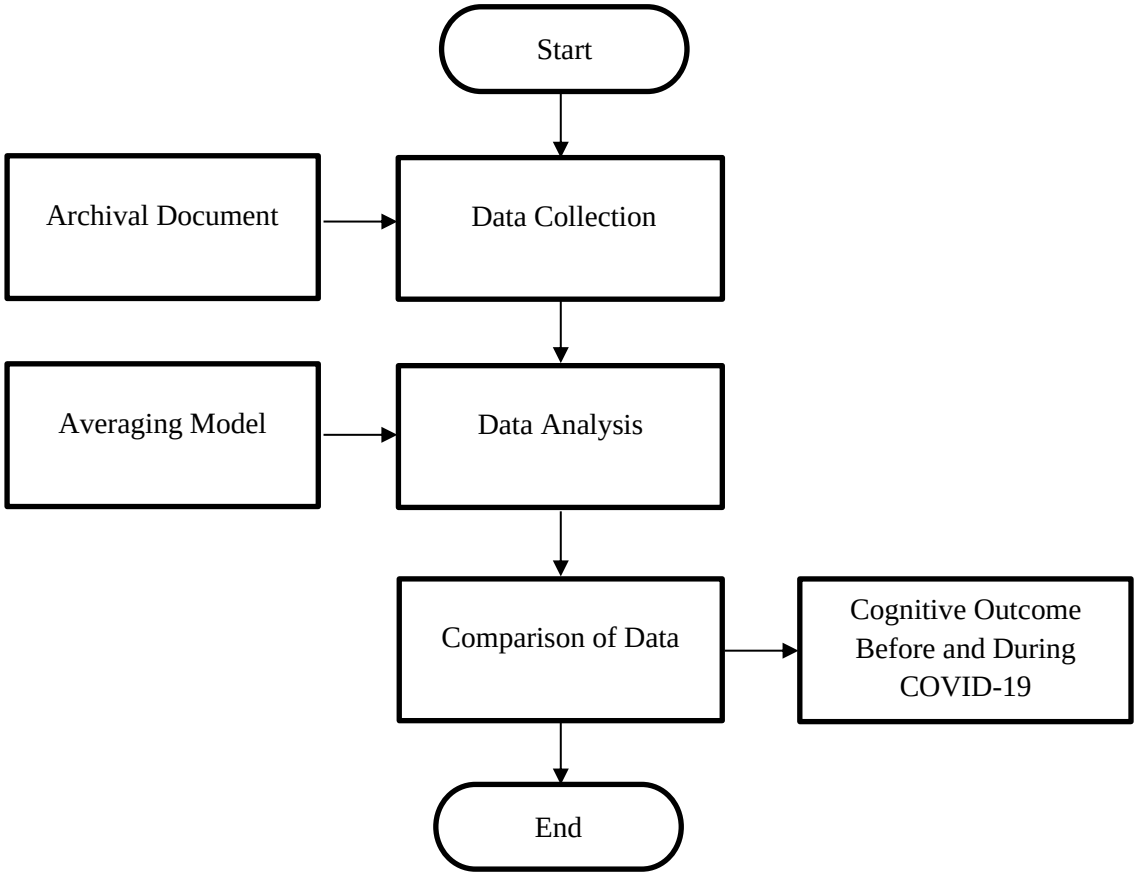


Figure 1: Method flowchart for analysing the attainment of the cognitive outcomes

**Data Collection**

Data has been retrieved from the archival documents containing cognitive programme outcomes for every semester from 20194 until 20214 and was recorded in the OBE Document. The provided raw marks are in terms of PO attainments for each course. The Course Coordinator is required to fill in the scores of students according to POs for the course, and the results of the PO attainments are automatically displayed. The data for 20194 involved students before the pandemic COVID-19, while the rest of the semesters (20202, 20204, 20212, and 20214) were during the pandemic hit globally.

**Data Analysis**

The values of PO1, PO2, and PO3 from all courses related to each student were collected in this study. Using an averaging model, the summation of each PO was divided by the number of courses related to obtaining the average PO score for each student. The value then can be observed to be either below or more than the passing value of the course, 50.

**Results and Discussion**

The data from cognitive POs was prepared, analyzed, and tabulated on a percentage basis. Figure 2 shows the comparison between cognitive PO attainments by the semester involved. The percentage value of PO1, PO2 and PO3 attainments for the semester 20194 is 53%, 49% and 54% respectively. These percentages are the lowest as compared to other semesters in 20202 until 20214, which was before the COVID-19 semester.

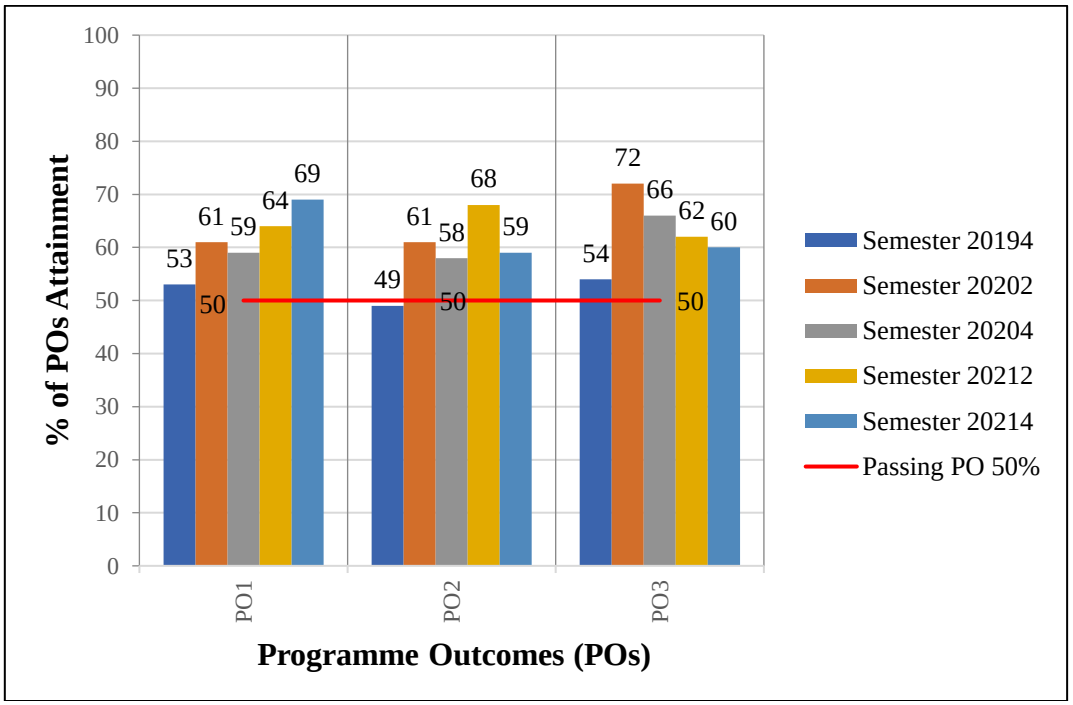


Figure 2: Cognitive POs attainment based on semesters involved

The highest percentage value of these three POs is 72%, contributed by PO3 in semester 20202. This is due to the introduction of Open Distance Learning (ODL) that was implemented owing to the lockdown MCO that started in March 2020. The percentages of all POs are slightly higher during this semester as compared to the previous semester (20194). This showed that the student's achievement had more improvement during this MCO semester.

However, the percentage of PO3 constantly dropped from 66% to 60% in 20204 until 20214. The constant drop recorded might be due to fatigue or the high-stress level in most students after a continuous lockdown implemented during these semesters, affecting their psychological and mental health. This is in line with an online survey conducted in the United States that also found that a majority of the participants were feeling increased stress and anxiety due to COVID-19 (Son *et al.*, 2020). The changes in assessment methods from group work to individual also contribute to the drop in performance among students and the percentages.

The percentage value of PO2 fluctuated between 58 % and 68 % during the COVID-19 semesters. Nevertheless, the percentage is still above 50% as compared to semester 20194 (49%). The average percentages of PO1, PO2, and PO3 of the four semesters during MCO (20202, 20204, 20212, and 20214) were 63.3%, 61.5%, and 65%, respectively. Compared to the semester before the pandemic outbreak (20194), these percentages have shown an increment of 10.3%, 12.5%, and 11% for PO1, PO2, and PO3, respectively. The increment of percentages recorded for all three POs from the result shows that the shift to online learning has a positive impact on students' performances in cognitive attribution.

Even though online learning is not explicitly new in education, including engineering, the unprecedented circumstances of the COVID-19 pandemic worldwide have urged most educational institutions to shift from the traditional face-to-face method to online education in an abrupt transitional time. Lecturers have enough time to design courses for online learning, but there is no direct interaction between lecturer and student (Momna & Ayesha, 2022). Converting the course to the online format is time-consuming and requires the willingness of educators to learn and be familiar with various teaching tools within a limited time of training and implementation (Ryan *et al.*, 2012).

The availability of online learning materials provided by educators and other sources in various forms**,** including lecture videos**,** has enabled students to easily access the from anywhere at any time possible. This is also agreed upon by Adedoyin & Soykan (2020) in their research findings. Vielma & Brey (2021) mentioned in their study that students find the ability to re-watch lectures that were recorded before the synchronous section is effective. This is especially beneficial for struggling students because it allows them to learn at their own pace rather than relying on the limited traditional face-to-face classroom time.

However, the perception of the faculty's availability in terms of office hours and responsiveness shows the most effective aspect among students (Vielma & Brey, 2021). In addition, considering students' mental health and socioeconomic status, the flexibility in adjusting the submission date of assignments, projects, and other assessment methods helps in filling the educational gap created by the sudden transition to online classes. Compassionate interactions, as well as empathy shown by the educators in acknowledging the challenges faced by students, have allowed them to be more flexible and accommodative in meeting deadlines (Stanton-Salazar & Valenzuela, 2001; De Bruyckere & Kirschner, 2016). Since the home environment has a big influence on how individual behave while engaging in e-learning, Prasetyanto *et al* (2022) suggested raising parents' awareness of the needs of students in online classes so that they are not overburdened with other responsibilities that conflict with their duties as students.

Saving a significant amount of money, less commuting time, improving time management skills and spending more time with family members are other benefits of online learning for students during the pandemic (Almaiah *et al.*, 2020; Armstrong-Mensah *et al.*, 2020). Meanwhile, the preference of students toward online learning over traditional face-

to-face lessons may be influenced by many factors, including their personality type (Bolliger & Erichsen, 2012; Ngampornchai & Adams, 2016; Keskin & Yurdugul, 2020). Students with high self-regulation character tend to have the ability to set goals, effective time management, problem-solving capacity, and awareness of time to seek advice (Ngampornchai & Adams, 2016; Keskin & Yurdugul, 2020). Other factors that contribute to their preference for online learning include having an online learning motivation, a self-efficacy constraint, and a high task value (Keskin & Yurdugul, 2020; Amir *et al.*, 2020).

However, online learning has also increased the chances of distraction and loss of opportunity for peer interaction (Cao *et al.*, 2020). Besides, effective online learning assessment settings need to be developed and proposed to prevent plagiarism and cheating (Baron & Crooks, 2005; Lee-Post & Hapke, 2017). Cheating during online examinations remains one of the great concerns and needs to be highlighted by adopting other alternatives to ensure the quality of students produced by the institution is at par with the industry requirements once they are graduated. A survey conducted by Asgari *et al* (2021) indicated that the use of cameras and microphones to proctor online exams may raise equity and privacy concerns among students. Therefore, substantive studies need to be conducted among stakeholders to propose strategies and provide solutions to enhance online learning outcomes, especially in this new normal.

## Conclusion

Cognitive programme outcomes attainment has shown improvement during the pandemic COVID-19, especially PO1 and PO2 for students of the Diploma in Civil Engineering. These findings were mostly influenced by the change in study method during the pandemic, in which all teaching and learning processes were conducted online. Using this method, students can repeatedly study through videos and recorded classes compared to face-to-face instruction, where absent students would be left behind. All online materials provided by lecturers would help students in their learning activities since PO1, PO2, and PO3 are related to knowledge, problem analysis, and design or development of solutions.

However, during the pandemic COVID-19, examinations were conducted online, which could not be well monitored by the lecturer. This may lead to the opportunity for students to cheat on their exams. Hence, advanced research needs to be conducted to improve methods to invigilate students during an online examination. Besides, the assessment weightage needs to be reviewed to reduce student learning time (SLT) as they have spent too much time on completing tasks given and meeting deadlines due to the modification of assessments conducted, including changes in types of assessment and changes in group work to individual work.

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