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Measuring Program Outcomes for Diploma in Electrical Engineering (Electronic) at UiTM Cawangan Pulau Pinang using OBE-ANAS System

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Abstract

The implementation of Outcome-based Education (OBE) has become an obligation in all public and private institutions of higher education, especially in engineering programs. OBE's main approach is focusing on what students should learn and obtain their outcomes ongoing and after finishing their learning process. The engineering program offered by higher education institutions should specify their outcomes and it is required to measure their performance, especially the program outcomes (POs). In this paper, a tool for analyzing the program outcomes for evaluation and accreditation by the professional body is presented. The tool was developed by the OBE committee unit, known as the OBE-ANAS system, and is used to obtain the overall POs performance. This tool is used to analyse POs of the Diploma Electrical Engineering (Electronic) with the program code CEEE111. The OBE-ANAS system consists of two main parts: the graphical user interface (GUI) and the database system. The tool provides information about the overall POs performance that can be easily evaluated by the lecturers. Two types of analysis are conducted to evaluate POs which are POs average and density. Based on this analysis, the Degree of Program Achievement (DPA) is used to monitor its achievement for every semester. In addition, all the measurement types are positioned with the program's key performance indicator (KPI). Therefore, the tool will be beneficial for the faculty for the accreditation process and achieving the program KPI set by the faculty.

Keywords: Outcome-Based Education, Program Outcome, Course Outcome, Continuous Quality Improvement, Accreditation.

Outcome Based Education

Outcome-based Education (OBE) is a teaching and learning structure that emphasizes students' mastery according to the program outcome which is set by the faculty. It was recognized as an education theory to improve the teaching structure to the earning outcome (Barr & Tagg, 1995; Kanmani & Babu, 2015). Thus, practising OBE is one of the requirements for the accreditation process (Bassi et al., 2016; Rajak et al., 2019; Saad & Haque, 2020; Zaini et al., 2011). In Malaysia, the Engineering Technology Accreditation Council (ETAC) is a body by the Board of Engineers Malaysia (BEM). It provides an accreditation process for

Engineering Technology and Engineering Technician education programs which are offered by the institutions. ETAC plays an important role in ensuring that recognized engineering technology bachelor's degree programs, engineering diplomas and engineering technology diploma programs are equivalent to engineering degrees from other countries signed through the Sydney Accord (SA) and Dublin Accord (DA) (BEM, 1972).

The Centre for Electrical Engineering Studies Universiti Teknologi MARA Cawangan Pulau Pinang has two diploma programs and one of them is Diploma in Electrical Engineering (Electronic), CEEE111. This program will be going through the process of accreditation at the end of 2013. A Self-Assessment Report (SAR) is a document consisting of the planning, implementation, assessment, and evaluation of the program conducted by the faculty and will be presented during the accreditation process. As stated in the manual by ETAC (2015), there are seven (7) criteria that are needed to be fulfilled by the program and one important criterion is the OBE. In the OBE model, three (3) main attributes are required to evaluate its outcome which are the course outcome (CO), program outcome (PO) and program educational objective (PEO) (Bisoyi et al., 2015). All these outcomes are mapped together and to ensure they can be achieved, teaching components and activities should be well-planned, organized and continuously improved (Spady & Marshall, 1991).

Continuous improvement quality (CQI) becomes a major requirement in the OBE implementation process (Saad and Haque 2020). Each outcome will have the evaluation phase as its final stage and carry out any issue and action to be taken. The evaluation of the achievement of each PO formulated by the faculty needs to be measured. Thus, in the POs attainment measurement when the number of students and courses offered by the program is increasing it will lead to complexity, inefficiency and susceptibility to human error. Therefore, an automated system to measure and analyse is required (Rajak et al., 2019; Saad & Haque, 2020) Our main goal in this paper is to come out with an OBE tool for significant measurement activities, particularly to measure and analyse PO attainment. The advantage of the developed system is to facilitate the POs attainment score which is centrally managed and the diversity of parties that can collaborate simultaneously throughout the system.

OBE-ANAS System

The Outcome-based Education Analysis System (OBE-ANAS) consists of two main parts which are a graphical user interface (GUI) and a database as data storage. These two parts are the core of the implementation of an online system. The GUI was developed using Microsoft Visual C# programming language while the database parts used Microsoft SQL Server. The design interface is illustrated in Figure 1.

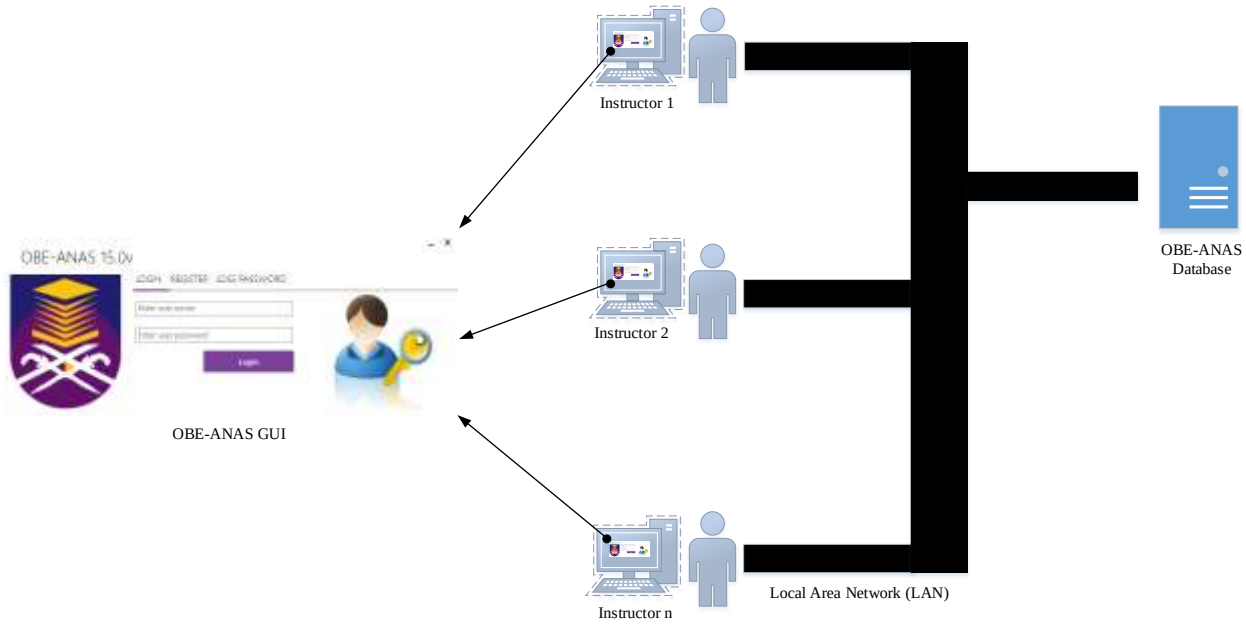

Figure 1: OBE-ANAS online system.

The POs attainment score is obtained from the course evaluation process where the marks are collected based on the student's achievement in terms of OBE. Here, the OBE unit has designed a course evaluation template known as "Course Template" based on Excel as shown in Figure 2. This template is used by the faculty, particularly the EEE111 program to analyse students' scores based on the COs and POs marks which are listed in the courses. The assessment such as tests, practical tests, assignments, mini-projects and other assessments which are related to the course profile are analysed at the end of the semester. By using the same template, the course coordinator will analyse the final marks obtained by the students and perform CQI (course level) process. In the CQI process, a course report is generated. The report contains information about the COs and POs from the previous and current semesters, as information on the current issue and future action plan. Figure 3 shows a sample of CQI which is used by the course coordinator to present their course performance in the CQI meeting.

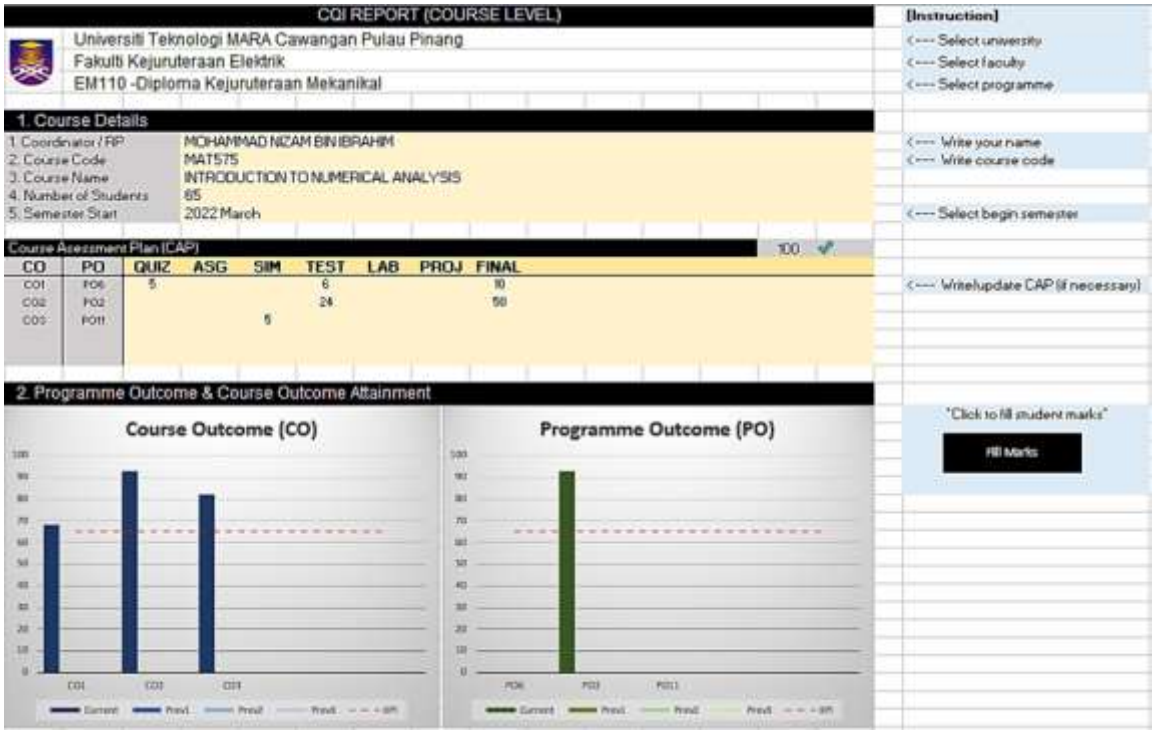

Figure 2: Course Template page.

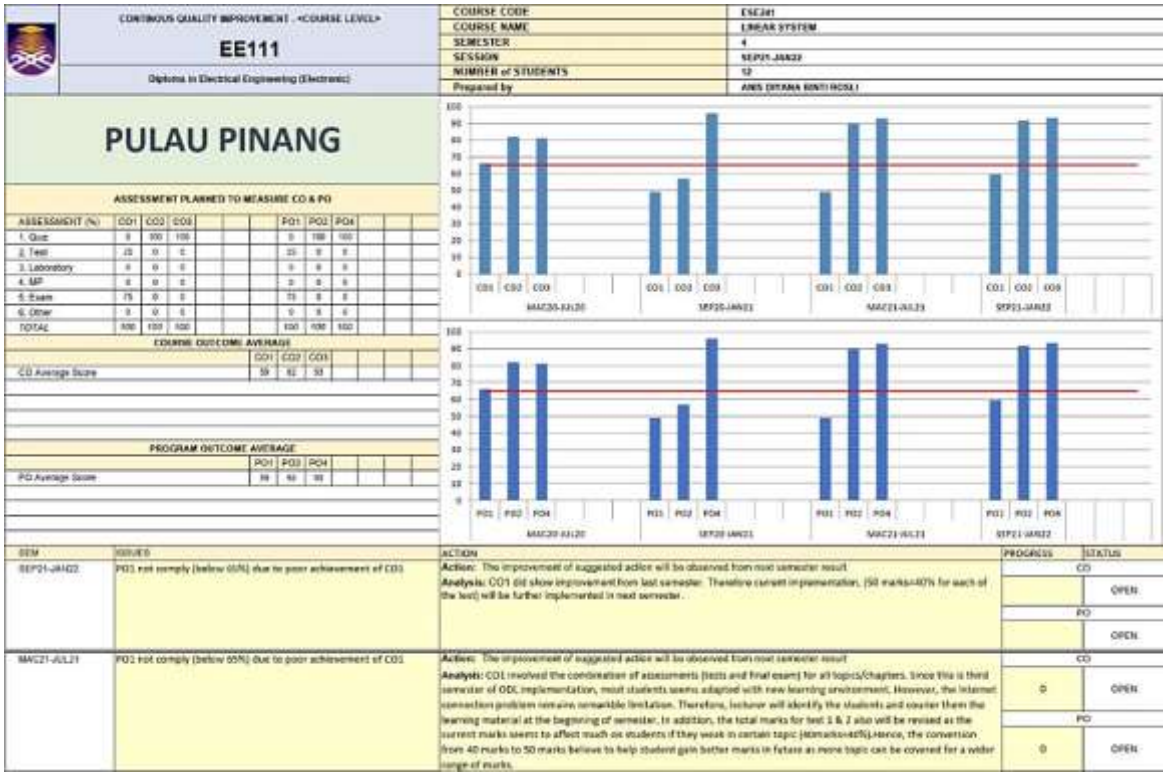

Figure 3: CQI sample report.

After filling in the requirement on the “Course Template”, the course coordinator will use the OBE-ANAS GUI tool to upload student scores into the database and a sample of student marks as shown in Figure 4. The upload procedure from the “Course Template” and OBE-ANAS tool is illustrated in Figure 5. From the OBE-ANAS tool, all the student’s marks will

be automatically updated in the database. Each mark of the students will be synchronous according to their intake based on the course selected. OBE-ANAS will also detect any uploaded information which does not tally with the database such as student information, course CO and PO mapping related to the course. The system will notify the user if the information is not valid, and the upload process will be terminated automatically.

Figure 4: COs and POs student assessment score.

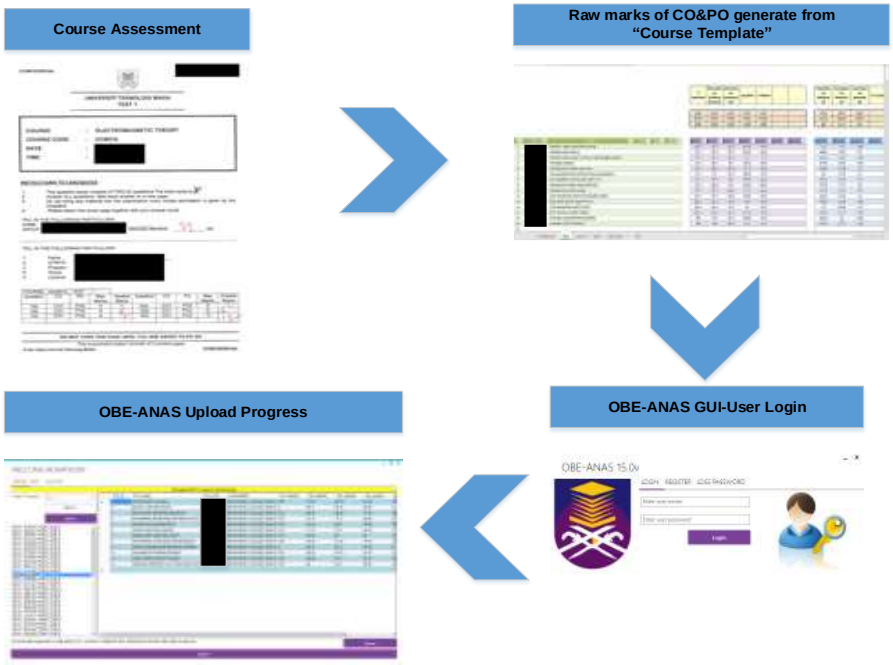

Figure 5: Upload procedure.

After all courses in the programme have been uploaded into the OBE-ANAS database by the course coordinators, the OBE committee will use the same tool of OBE-ANAS to analyse the Pos achievement in the corresponding semester. Figure 6 shows the OBE-ANAS Pos section analysis which has been utilised to determine individual student Pos achievement, and overall Pos analysis results.

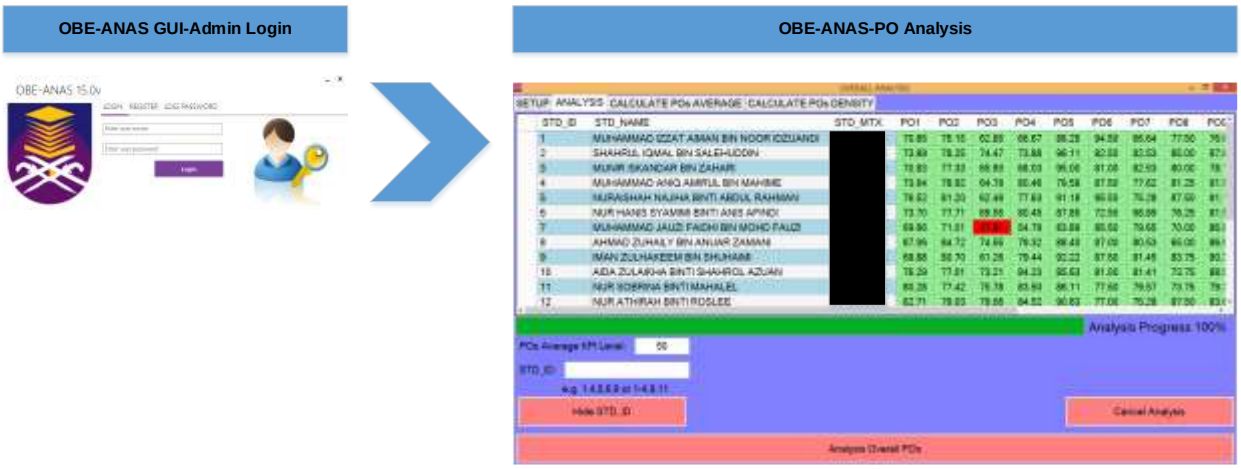

Figure 6: OBE-ANAS PO analysis.

Results and Discussion

The POs achievement for CEEE111 program was implemented in two ways of analysis which are PO average and density attainment. The POs achievement is based on actual students' data which is uploaded by courses coordinators. The PO average attainment is obtained by averaging the PO marks of a batch of students from courses which are mapped to the same PO (e.g. PO1). As illustrated in Table 1, assumes that the total number of students for the first batch is five and only three courses (Course A, Course B, and Course C) are addressing the PO1.

Table 1
Calculation example for PO Average (Batch=1, PO=1).

Matrix	Student Name	Batch	Course A (PO1)	Course B (PO1)	Course C (PO1)	Average PO Score (%)	Average PO Score ≥ 50
2019xxxxx1	Name1	1	70	80	90	80	√
2019xxxxx2	Name2	1	80	65	80	75	√
2019xxxxx3	Name3	1	70	60	65	65	√
2019xxxxx4	Name4	1	40	50	45	45	×
2019xxxxx5	Name5	1	50	30	58	46	×
$N_S = 5$							$S_{\geq 50} = 3$

Each mark obtained by the students for each course is calculated and then, the total averaging for PO1 is calculated. In order to obtain the final score of the PO1 attainment, the averaging score again is calculated as follows:

PO1 Average = (Average marks obtained by each student)/(Total number of student)
= (80%+75%+65%+45%+46%)/5
= 62.2%

Next, the PO Density measurement for the CEEE111 program, The PO Density shows the number of students for a particular batch whose average PO score is equal to or exceed 50 marks (pass marks) and then the percentage of the density is calculated. By using the same data example shown in Table 1, the PO Density score is calculated as follows:

Number of student ≥50 (S(≥50)) = 3

Total number of students (N_s) = 5
PO Density (%) = (S_(≥50)/N_s ×100%)
= (3/5×100%)
= 60%

For each POs analysis attainment, the faculty will set the Key Performances Indicator (KPI) that needs to be complied with by each PO. For example, for the POs average analysis the KPI is set at 65% while for POs density analysis is set at 75%. Figure 7 and Figure 8 show the sample of POs Average and Density respectively for the intake in September 2020.

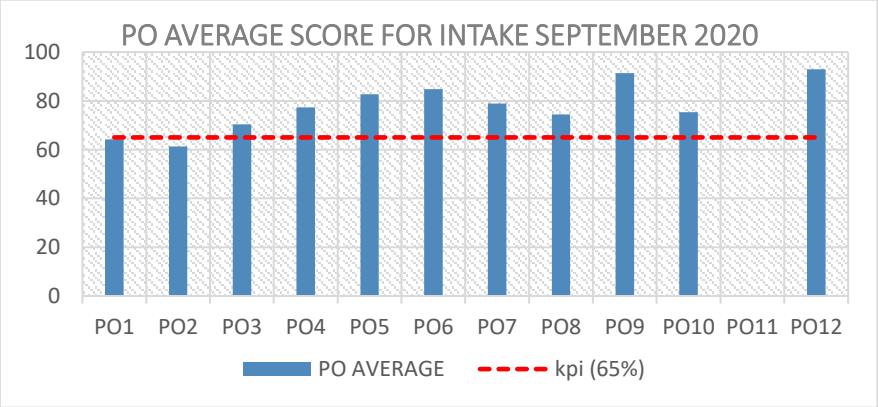

Figure 7: POs Average score for the intake September 2020.

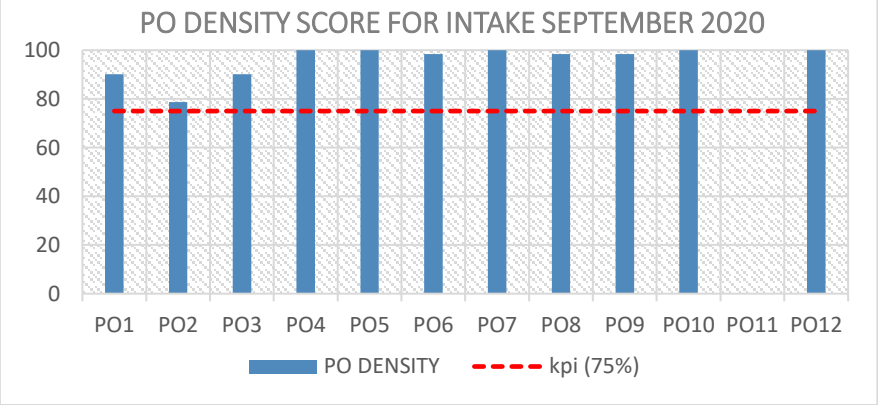

Figure 8: POs Density score for the intake in September 2020.

Based on the analysis of PO average and density which are obtained for each student intake, the Degree of Program Achievement (DPA) analysis is performed. This analysis is implemented to observe and monitor each intake of the CEEE111 program until the end of their study. The DPA analysis is obtained by counting the number of POs that exceed the KPI target for each analysis (average and density) and its percentage is calculated. By referring to Figure 7 for analysis POs average, the number of POs that exceed KPI is nine out of eleven and its DPA-POs Average is 82% while for the POs density (as referred to Figure 8), the DPA-PO Density analysis is the same as DPA-POs Average and the score obtained is 100%. In the DPA analysis, the faculty also set the KPI, which is set at 50%. Figure 9 and Figure 10 show the sample of DPA analysis for both POs average and density for the intake in September 2020.

Figure 9: DPA-PO Average for the intake September 2020.

Figure 10: DPA-PO Density for the intake in September 2020.

Conclusion

The successful implementation of OBE, in particular of POs measurement becomes an important element in the process of accreditation. Thus, an effective measurement tool has been developed known as OBE-ANAS to analyse program outcomes. With this systematic online interactive tool, the system is able to measure individual POs attainment and then used it to measure the PO average and density attainment. The DPA analysis also is proposed to monitor the trend of the program of the batch until they finished the study. Each evaluation is positioned with KPI benchmarks which have been agreed upon by faculty members. The KPI benchmark is referred to as a targeted indicator for the faculty to observe the program performance from time to time. As a result, the developed system was believed to benefit the faculty to achieve the target.

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