

Program Outcomes Assessment during the New Normal: An input to Continuous Quality Improvement

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Highlights

- The variations in the program outcome assessment results for the two periods of analysis does not have significant difference
- Students got difficulty in research and design courses during the online set up

Abstract

The paper presents the model concept of the Outcome-based Education (OBE) framework as implemented in the College of Engineering of FEU Institute of Technology's different engineering programs as an input to the Continuous Quality Improvement (CQI). CQI is a management philosophy that FEU Institute of Technology uses to level efficiency and internal and external satisfaction. It is an iterative process that seeks to evaluate the educational organization and improve its processes. The implementation of CQI in the College of engineering is based on the output of the Outcome-based Education (OBE) approach as mandated by the Commission of Higher Education (CHED) and the Philippine Technological Council. The FEU Institute of Technology adopts assessment methods to measure the student outcomes or program outcomes (POs). The assessment method used to evaluate the student outcomes are the rubric for course works and the examination scores for summative examination. The scores in the rubrics and assessments were evaluated and reveals that some POs were rated below the threshold, but majority of the indicators had attained the target threshold of 50% which was set by the CQI committee. The data shows that some POs are below the 50% threshold based on the two (2) periods of evaluation. Students got difficulty on the submission and completion of thesis projects and computational design requirements in some of the major courses such as design subjects. For EE and ME, all the POs were attained which implies that the students got a satisfactory rating in their assessments. The improvement in the assessment and evaluation process is continuously implemented to achieve better outcomes. The Program Directors spearhead the maintenance of the CQI Program in coordination with the Engineering Coordination Committee and the Quality Assurance office. The findings show no improvement.

Key Words: continuous quality improvement, engineering, new normal, outcome-based education, program outcomes,

1. Introduction

Outcome-Based Education (OBE) is an approach that focuses on outcomes, where the achievements of students are measurable, proven and can be improved (Karman et. al, 2011). This approach following the Outcome-Based Education (OBE) Framework was introduced by the Commission on Higher Education

(CHED) and the Philippine Technological Council (PTC). Traditional education is the opposite of OBE in terms of planning and assessment. There is a shift in measuring input and process since the output or the outcome is also being included in the assessment and measurement. OBE approach is focused on designing the curriculum in which the institution produces graduates that will meet the demands of the industry. In the OBE approach, students are expected to do challenging tasks rather than merely memorizing principles and theories. Therefore, the OBE approach prepares the students to become completely equipped with all the different skills required by the industry that will be hiring the graduates. To overcome this issue, there is a need for continuous quality improvement for an effective outcome-based education implementation (Sikander et. al, 2017).

The CHED had mandated the use of the OBE approach in the tertiary education in the Philippines, and the FEU Institute of Technology has adopted such framework. At present, all engineering programs of the FEU Institute of Technology were awarded by PTC with level 1 accreditation. The school offers the following engineering programs: civil engineering, computer engineering, electrical engineering, electronics and communication engineering, and mechanical engineering. Outcome-based education means starting with a clear picture on the student's ability and capability and organizing the curriculum, instruction, and assessment (Spady, 1994). Thus, in every educational model, OBE highlights the cognizance of the CQI process (Tanjong et. al, 2020).

Continuous quality improvement (CQI) is a management philosophy that organizations such as the FEU Institute of Technology use for waste reduction, leveling efficiency, and satisfaction internally and externally. It is an iterative process that seeks to evaluate the organization's workings and improve its processes. The philosophy behind CQI is that challenges faced by the organization involve, in most cases, more processes and less of people. To a large extent, contributing factors to this are poor work design, vague instructions, leadership failure, and the like. Organizations that have fully imbibed CQI in the work culture encompass everyone from the top management to the rank-and-file employees who are concerned with it. CQI emphasizes the need for teamwork. It also maintains the stand that all employees are important people in the team. When there is synergy amongst team members, then faculty and staff members would be encouraged to review their work processes and propose methods of improving these processes for the good of the institution. In the end, efficiency is improved, and the quality of education also rises along with the learning condition of the students.

The main objective of the paper is to assess the attainment of the program outcomes based on the target percentage set by the college of engineering. The data gathering was taken from the two (2) cycle periods based on the Outcome Based Education outcome assessment. The findings will be used as an input to the CQI and to enhance the percentage attainment during the new normal period.

2. Methods

2.1 Assessment Methods

Student assessment covers the whole semester coursework and the final examination. The assessment method used to evaluate student outcomes for coursework is the direct method using rubrics while for the final examination is the score in the exam. For courses that are identified for assessment, the Program Outcome Evaluation Summary Report is further summarized and evaluated at the department level for possible improvement as they are directly demonstrative of the student outcomes. The same assessment method is used in each of the POs. The subjects selected are the same for both periods and the requirements needed in the evaluation are the same.

2.2 Data gathering

All the courses assessed were gathered during the SY 2020-2021 and SY 2021-2022. The two (2) periods were used to assess the progress in the student outcomes as various measures and enhancement in the learning management system were implemented during the pandemic period. The College of Engineering initially set the satisfactory outcomes to a rating of 4 for at least 50% of the class passed in every student outcome for every course. Based on the yearly results, this target could go higher or lower depending on the target set by the Continuous Quality Improvement committee of the college. For the current evaluation, 50% is the target threshold. It is hoped, however, that the goal will increase to a higher level through the years as more and more students are able to demonstrate to a satisfactory level the program outcome of a concern. Same target threshold was used in the two cycles. To assess the difference of the level of attainment, same requirements and assessment method were used in both two periods of evaluation.

2.3 Program Outcomes

The FEU Institute of Technology adopts the program outcomes required by the Commission on Higher Education (CHED) and of the Philippine Technological Council (PTC). Each engineering program had selected subjects that were assessed per program outcomes.

The following program outcomes are used in the College of engineering: (A) ability to apply knowledge of mathematics and science to solve complex engineering problems, (B) ability to design and conduct experiments, as well as to analyze and interpret data, (C) ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability, in accordance with standards, (D) ability to function on multidisciplinary teams, (E) ability to identify, formulate, and solve engineering problems, (F) understanding of professional and ethical responsibility, (G) ability to communicate effectively, (H) broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context, (I) recognition of the need for, and an ability to engage in life-long learning, (J) knowledge of contemporary issues, (K) ability to use techniques, skills, and modern engineering tools necessary for engineering practice, (L) knowledge and understanding of engineering and management principles as a member and leader in a team, to manage projects and in multidisciplinary environments, (M) ability to assess and evaluate power systems operations under normal and abnormal conditions., and (N) ability to analyze the operating principles related to power generation from non-conventional sources of energy. The POs “M” and “N” are intended for the EE department only.

2.4 Subjects assessed

Table 1 shows the list of subjects that were assessed on the program outcomes per degree program. The subjects identified are for summative assessment either from the coursework output or the final examination result. Each program identified the subjects to be evaluated based on the indicators per program outcome. One (1) subject was selected per POs for the evaluation. The assessment method depends on the required output of the PO like for laboratory and thesis evaluation, rubrics were used to assess the attainment of POs, while for computational subjects, the scores in the final examination were utilized.

Table 1. List of subjects assessed for POs

POs	CE	CpE	EE	ECE	ME
A	Theory 2 (CETHEORY2)	Logic Circuits and Switching Theory	AC Machinery	Electromagnetics	Heat Transfer
B	Hydraulics Laboratory (CEHYDRAULICSLAB)	CpE Practice and Design 2	Instrumentation and Measurement laboratory	Pulse & Switching Electronics (Lab)	ME Lab 3
C	Steel Design (CESTRUCT2)	CpE Practice and Design 2	Project Study 2	Project Study 2	ME Project Study 2
D	Thesis 1 (CEPROJECT1 and CE0057)	CpE Practice and Design 2	Project Study 1	Project Study 1	ME Project Study 1
E	Structural Design 1 (CESTRUCT1)	Embedded Systems	Power Systems Analysis and Design	Data Communications 1	Machine Design 1
F	CE Laws and Ethics (CELAWS)	Computer Engineering as a Discipline	EE Laws, Contracts & Ethics	ECE Laws, Contracts, & Ethics	ME Laws
G	Thesis 2 (CEPROJECT2)	CpE Practice and Design 2	Project Study 2	Project Study 2	Methods of Research
H	Thesis 2 (CEPROJECT2)	CpE Laws and Professional Practice	Project Study 1 / Project Study 2	Project Study 1	ME Project Study 2
I	Seminars & Fieldtrips (CESEMINARS)	CpE Laws and Professional Practice	EE Seminars & Fieldtrips	ECE Seminars & Fieldtrips	Automotive Engineering
J	Seminars & Fieldtrips (CESEMINARS)	Seminars and Fieldtrips	EE Seminars & Fieldtrips	ECE Seminars & Fieldtrips	Industrial Processes and Plant Inspection
K	Computer Application in CE 2 (Lab) Computer Application in CE 1 (Lab)	Computer Networks and Security	Illumination Engineering Design (Lab)	Data Communications 2	Machine Design 2 Lab
L	Construction Project Management (CECPM)	CpE Laws and Professional Practice CpE Practice and Design 2	EE Technopreneurship / Project Study 2	Project Study 2 ECE Technopreneurship	ME Project Study 2
M	NA	NA	Elective 2 (Protective Relaying)	NA	NA
N	NA	NA	Electrical Power Plant Design (Lab)	NA	NA

2.5 Statistical Treatment

The paper tested the hypothesis that there is no significant difference on the program outcomes between the two (2) periods. To test the hypothesis, the Mann-Whitney U test was utilized.

3. Results and discussion

3.1 OBE Framework

The drafting and formulation of the Institutional Vision-Mission (IMV) and the Program Educational Objectives (PEO) involves the participation of the various constituents such as industry partner, alumni, faculty, students, administrators, and government. Inputs and feedback are gathered through consultative meetings. Course Learning Outcomes (CLO) are based on the Program Outcomes (PO) which are adopted either from the Philippine Technological Council (PTC) Accreditation Board for Engineering Technology (ACBET) or the Commission on Higher Education (CHED) Memorandum Order on the implementation of outcomes-based education. The IMV, PEO, PO and CLO must harmonize and must be consistent with each other and assessed and evaluated periodically regarding their attainment. The entire process follows the continuous quality improvement principle wherein the results of the evaluation are used to refine the outcomes. The components of the Outcomes-Based Educational system are depicted in Figure 2.

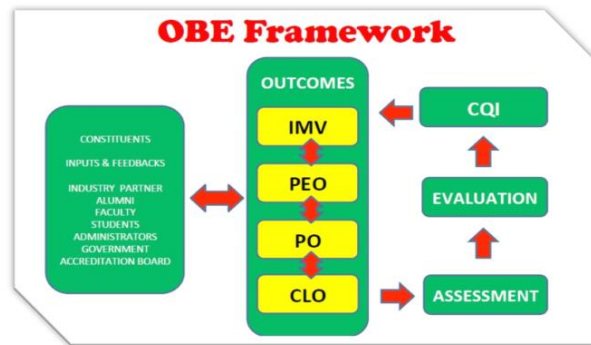


Figure 2. FEU Tech OBE Framework

3.2 Program Outcomes

Based on the rubrics and examination scores, the results are evaluated against the target. If the outcome is attained, the faculty may recommend setting a higher goal next time. If not, they can also suggest ways on how the corresponding level of performance may be maintained. Otherwise, he/she would recommend how the students' performance may be upgraded. Such recommendations may include revision of syllabus to include an enhancement topic, adjustments in the pedagogy, purchase of additional books and equipment and the like. These recommendations are recorded and would be reviewed by the Director and the Faculty-in-Charge of the course for its next offering. The process is similar to the study of Tanjong et. al (2020) that mentioned on the importance of educators to understand and engage with matters pertaining to engineering education development, and this can be achieved by constant evaluation of student outcomes through course delivery and assessments. The FEU Institute of Technology has always strived to bring excellence in the delivery and quality of content in the educational system. Together with the policies set forth by the Commission on Higher Education on how HEI's may conduct our pursuit of providing education and the initiatives of FEU Institute of Technology, the MILES (**M**astery-**B**ased **I**ndividualized **L**earning **E**nhancement **S**ystem) was born. It is the solution to providing quality education to our students at the safety of their own homes by teaching them through online facilities such as the CANVAS learning management system to provide the necessary educational materials, ZOOM meetings to conduct live online classes and demonstration of necessary principles, and iCARE (**i**Tamaraw **C**enter for **A**cademic **R**esources and **E**nrichment) via ZOOM where students may consult with their respective teachers for tutorial classes/sessions or consultations to address the academic needs of the student.

Table 2 presents the result of the POs evaluation. Some POs were rated below the threshold, but majority of the indicators had attained the target threshold of 50%. For the CE department, the data the following POs have recorded an attainment below the 50% threshold are A, B, C, D, E, F and L. Students got difficulty on the submission and completion of thesis projects and computational design requirements in some of the major courses such as design subjects. During the first term of SY2020-2021, laboratory subjects were not offered, thus having a score of zero in PO B. For CpE, only indicator 2 of PO B got below the 50% threshold, while the rest of the POs were attained. For ECE, PO A recorded a lower attainment percentage, below the target 50%. The students have difficulty in applying knowledge in mathematics and science. For EE and ME, all the POs were attained. The data implies that the students got a satisfactory rating in their assessments.

Table 2. Results of POs assessment in percentage

PO	Indicators	CE		CpE		EE		ECE		ME	
		20-21	21-22	20-21	21-22	20-21	21-22	20-21	21-22	20-21	21-22
A	1. Apply knowledge of mathematics to solve engineering problems.	9*	80	83	73	53	100	65.85	36.9*	73.33	100
	2. Apply knowledge of science to solve engineering problems.	74	100	63	48*	53	62.5	58.54	38.5*	73.33	98.53
B	1. Design experiments	na*	95	100	78	70	100	80	100	100	94.74
	2. Perform experiments	na*	95	57	67	70	88	88	100	100	94.74
	3. Analyze data	100	95	87	67	100	88	60	100	100	94.74
	4. Interpret data	100	95	86	78	100	50	72	100	100	31.58
C	1. Design a system, component, or process to meet desired needs.	44*	25*	100	89	100	68.8	90.24	67.5	73.08	88.89
	2. Consider realistic constraints	44*	25*	100	78	50	84.4	95.12	100	65.38	55.56
D	1. Demonstrate team work to complete the assigned tasks.	73	18*	96	100	77.78	100	96.55	100	100	100
	2. Utilize knowledge from another discipline	73	18*	100	100	72.22	100	100	100	90.32	100
E	1. Identify engineering problem	79	47*	88	100	100	79.2	78.26	60	75	93.33
	2. Formulate engineering problem	80	47*	94	100	100	79.2	78.26	60	75	93.33
	3. Solve engineering problem	81	61	94	100	100	79.2	78.26	60	58.33	57.78
F	1. Demonstrate an understanding of the engineer's code of ethics.	7*	93	84	96	86	71.4	78.38	88.24	96.97	100
	2. Identify ethical issues in engineering practice.	12*	93	84	96	93	71.4	75.67	82.35	60.61	100
G	1. Produce technical reports, presentations, and other documents.	93	100	100	81	50	78.1	41.78	75	81.13	84.91
	2. Present technical concepts or ideas to an audience.	93	100	100	92	50	93.8	92.98	95	18.87	86.79

H	1. Identify the global, economic, environmental, and societal issues in engineering applications.	90	100	90	100	77.78	66.7	100	100	73.08	55.56
	2. Assess the impact of engineering solutions in addressing the global, economic, environmental, and societal issues.	90	100	81	100	100	84.4	95.12	100	67.31	55.56
I	1. Recognize the need for life-long learning	100	100	96	100	100	69	100	100	90.24	97.05
	2. Engage in life-long learning	100	100	89	100	100	69	100	100	92.68	97.05
J	1. Identify recent trends and issues in engineering.	100	100	83	100	100	73.3	100	100	75.76	86.96
K	1. Use techniques and skills necessary for engineering practice.	97	95	97	86	93	90	81.48	96.77	94.23	92.68
	2. Use modern engineering tools for engineering practice	97	95	94	89	93	90	88.89	96.77	94.23	100
L	1. Explain engineering management principles	8*	74	93	100	100	100	85.37	100	73.08	88.89
	2. Apply engineering management principles to manage projects in multidisciplinary environments	64	100	100	100	100	100	100	100	78.85	88.89
M	1. Assess and evaluate power system during abnormal conditions like fault using protective relays.	-	-	-	-	100	100	-	-	-	-
N	1. Analyze the operating principles related to power generation using renewable energy.	-	-	-	-	97	100	-	-	-	-

Note: * below the 50% threshold
na – not applicable

3.3 Statistical Analysis

Table 3 presents the computed statistical values using the Mann-Whitney U Test. The statistical analysis was used to test the null hypothesis that there is no significant difference on the program outcomes between the two (2) periods of assessment. The findings revealed that the Mann-Whitney U test values exceeds the level of significance of 0.05 in all the engineering programs, thus accepting the null hypothesis. It can be implied that the program outcomes attainment from SY2020-2021 and SY2021-2022 are the same and no improvement at all. The result reveals that the POs of the two periods does not differ significantly which only shows that there is no enhancement or progress recorded on the second period of assessment. It can be implied that the enhancement measures done by each of the engineering department based on the first cycle evaluation was not effective.

Table 3. Statistical Analysis Result

Variables	Sig. (Mann-Whitney U Test)	Remarks
CE POs (SY20-21 and SY21-22)	0.074	Accept the Null Hypothesis
CpE POs (SY20-21 and SY21-22)	0.693	Accept the Null Hypothesis
EE POs (SY20-21 and SY21-22)	0.368	Accept the Null Hypothesis
ECE POs (SY20-21 and SY21-22)	0.115	Accept the Null Hypothesis
ME POs (SY20-21 and SY21-22)	0.171	Accept the Null Hypothesis

4. Conclusions

In OBE implementation, the Continual Quality Improvement (CQI) process is designed by the College of engineering of FEU Institute of Technology. Yet, during the evaluation process, certain shortcomings and weaknesses may be viewed in different aspects of the implementation of policies and strategies, which should be improved. The findings conclude that the some of the program outcomes were not attained during the two (2) periods of assessment. The process is a cycle of assessment and feedbacking system and suggesting the improvement to attain the required threshold. During the online set-up the FEU Institute of Technology created the MILES (Mastery-Based Individualized Learning Enhancement System) to address the need of the online learning and as part of the enhancement measures to improve the attainment of the POs. It is the solution to providing quality education to the students while they are learning online with the use of online technology such as the CANVAS learning management system to provide the necessary educational materials, ZOOM meetings to conduct live online classes and demonstration of necessary principles, and iCARE (iTamaraw Center for Academic Resources and Enrichment) via ZOOM where students may consult with their respective teachers for tutorial classes/sessions or consultations to address the academic needs of the student. The statistical analysis result implies that the program outcomes attainment from SY2020-2021 and SY2021-2022 are the same and no improvement was recorded. It is recommended that further enhancement activities and remedial measures should be implemented during the new normal to improve the POs attainment rating. The remedial measures that were proposed based on the evaluation includes but not limited to, additional consultation hours for thesis advising, in the hybrid set-up the design and computational subjects should be scheduled in the face-to-face classes, videocoursewares and module materials should be revisited and revised based on the syllabus content, additional advising and consultation hours and conduct of tutorial classes.

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