

Assessment Method for Course Outcome and Program Outcome in Outcome Based Education (OBE)



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AN accredited engineering program is judged as providing satisfactory preparation of graduates to initially enter the profession as registered engineers, and then develop their skills subsequently to the level of professional engineers (Javed *et al* 2009). The accreditation process is designed to publicly assure the competence of graduates, independent of the certification and credentials provided by the institutions of engineering education. According to the EAC Manual 2007, "Program Outcomes are statements that describe what students are expected to know and able to perform or attain by the time of graduation. These relate to the skills, knowledge, and behaviour that students acquire through the programme." From the EAC Manual, students of an engineering programme are expected to attain 10 program outcomes as follows:

- (i) ability to acquire and apply knowledge of science and engineering fundamentals;
- (ii) acquired in-depth technical competence in a specific engineering discipline;
- (iii) ability to undertake problem identification, formulation and solution;
- (iv) ability to utilise systems approach to design and evaluate operational performance;
- (v) understanding of the principles of design for sustainable development;
- (vi) understanding of professional and ethical responsibilities and commitment to them;
- (vii) ability to communicate effectively, not only with engineers but also with the community at large;
- (viii) ability to function effectively as an individual and in a group with the capacity to be a leader or manager;
- (ix) understanding of the social, cultural, global and environmental responsibilities of a professional engineer; and
- (x) recognising the need to undertake lifelong learning, and possessing/acquiring the capacity to do so.

1.0 PRACTICABLE ASSESSMENT IN ENGINEERING PROGRAM

Assessment in Outcome Based Education (OBE) can be done in many different ways by the respective

institutions to reflect the process of Continuous Quality Improvement (CQI). Since the concept of OBE is relatively new, some may find that the assessment for OBE rather cumbersome and will take a lot of resources to keep track of students for every course at any given time. And this has to be done continuously for as long as the program needs to be accredited by the respective Engineering Accreditation Council as approved by the Washington Accord. The guide by the accreditation body is insufficient for any program owner to be confident of their assessment documentation. However, a method can be used to measure the achievement of the course outcome in relation to the program outcome which should meet the program objectives. The achievement of the program outcome needs to be measured so that continuous improvement can be done to upgrade the quality of engineering graduates.

There are two levels of assessment measurement; one is at the course level and the other is at the cohort level. For every course, the course attainment is recorded and later becomes an input to the cohort level assessment, which takes into account all courses taken by each cohort at any given semester. To ensure that the attainment is kept on record, several forms need to be produced by the course instructor and this will become the base for the next time when improvement needs to be done. The forms will include marks distribution and table for course outcome attainment as well as table for program outcome attainment.

2.0 COURSE OUTCOME MAPPING TO PROGRAM OUTCOME

Course Outcomes from Fluid Mechanics 1 are taken as a sample to be analysed. There are five associated course outcomes as decided by the instructor. They are as follows:

- CO1: Solve fluid statics based problems.
- CO2: Solve fluid in motion problems.
- CO3: Solve fluid friction in pipes problems.
- CO4: Solve fluid flow measurement problems.
- CO5: Apply the concept of dimensional analysis.

Table 1: Relation PO-CO

CO \ PO	1	2	3	4	5	6	7	8	9	10
CO1	2				3		1			
CO2	2				3		1			
CO3	2				3		2			
CO4	2				3		1			
CO5	2				3		1			

All of these Course Outcomes (CO) shall have linkage to Program Outcomes (PO) in such a way that the strongest emphasis has the value of 3, whereas the least emphasis is rated 1 (Table 1).

3.0 COURSE OUTCOME ATTAINMENT

For the detail assessment division, Table 2 indicates the subdivision of each question or assignment that relates to the specific COs. As shown in the table, for Test 1 (T1), there are four questions; Q1 and Q2 is to assess CO1, while for Q3 and Q4, they are for CO2 assessment. Similar cases for Test 2 (T2) applies, two of them are designated to measure CO3 and another two for assessing CO4. In addition, all CO1 to CO5 are also measured using assignments (Asgn) and Final Exam (FE). The column '% Total' contains 'a', 'b', 'c', 'd', 'e' which is the sum of each row normalised to 100. The column 'result' indicates whether each CO is achieved using the value from column '% Total'. The last column represents 'Yes' or 'No'.

Table 2: Detail assessment planning

Course Outcome	Assessment				% Total	Result
	T1	T2	Asgn	FE		
CO1	Q1,Q2		A1, A2	Q1	a	Y
CO2	Q3,Q4		A3, A4	Q2	b	N
CO3		Q1,Q2	A5, A6	Q3	c	Y
CO4		Q3,Q4	A7, A8	Q4	d	N
CO5			A9, A10	Q5	e	N

To measure the attainment for each CO, it is imperative to decide on the appropriate value of marks that will indicate that the CO is achieved. For example, an average 50 out of 100 may be chosen as the minimum level of marks needed to be obtained by students. If that is so,

$(Q1 \text{ from Test 1}) + (Q2 \text{ from Test 1}) + (A1 + A2) + (Q1 \text{ from Final Exam}) \geq 50\%$, then CO1 is achieved.

To best visualise the arithmetic, it is easier to take each mark as the portion of mark towards the final course score. Q1 from Test 1 may contribute just 3% towards the overall final score. Q2 from Test 1 might contribute just 2% and Assignments 1 and 2 give another 4%, and lastly, Q1 of Final Exam constitutes 5%. So altogether, the total mark that justifies CO1 is only 14% from the final overall score. To be able to say that CO1 is achieved for any student, they need to get at least 7% so that it counts as 50% of total possible score for CO1. A similar assessment needs to be done on other COs so that all COs are evaluated.

Table 3: Individual CO calculation

Student	CO1					Total (%)	CO Met (Y/N)
	Q1 (T1)	Q2 (T2)	Asgn 1	Asgn 2	Q1 (F.E)		
1. Ali	2	1	1	2	2	8	Y
2. Abu	0.5	0.5	1.5	2	2	6.5	N
3. Lai	1.3	1.5	1	1	5	9.8	Y
4. Raja	1.8	2	2	1	3	9.8	Y

4.0 PROGRAM OUTCOME ATTAINMENT

Next, the achievement of the COs needs to be linked to the achievement of the POs. To do this, value from Table 1 is used to calculate the score for PO. Table 4 shows the linkage from COs to the POs. The 'CO Result' column as shown is just an example of CO attainment. For this case, CO1, CO3 and CO4 are set as achieved, whereas CO2 and CO5 are set as not achieved.

Table 4: PO attainment table

CO \ PO	CO Result	1	2	3	4	5	6	7	8	9	10
CO1	Y	2				3		1			
CO2	N	2				3		1			
CO3	Y	2				3		2			
CO4	Y	2				3		1			
CO5	N	2				3		1			
PO Attainment		X				y		z			

From Table 4, for each of the CO that is achieved (Y), the weightage in the matrix is calculated towards the value of PO Attainment. From example, in Table 4, CO1, CO3 and CO4 is met, therefore the weightage is to be calculated from the overall sum of weightage for PO1. The bolded weightage represents the CO which is achieved.

For PO1, PO Attainment

$$= (2+2+2) / \text{Sum PO1_Weightage} * 100$$

$$= 6 / 10 * 100$$

$$x = 60\%$$

(Multiply by 100 to get the percentage of PO Attainment)


A similar calculation is done on PO5 and PO7. The calculated PO Attainment is only the partial contribution of one course towards the POs. In any case, all of the courses need to be evaluated the same way progressively. After getting the PO Attainment for all of the courses in the same semester, one can use the statistical method to determine the overall PO Attainment contribution for one semester. An average value may be used to get the distribution of the PO Attainment for all courses in one semester. Later, towards the completion of the four-year program, the program owner could get the overall PO Attainment for all the semesters. Only this final PO Attainment (for all semesters) can be considered as the POs measurement for any cohort or entry.

5.0 CONCLUSION

By adopting the OBE concept, one should at all times take measurement of the cohort progress. Any intervention can be done to improve the CO attainment as well as the PO attainment before the cohort finishing the program. After each cohort has completed the program, the overall PO Attainment can be based as a benchmark for the next cohort. In any case, the value or numbers from the PO Attainment is just a number, and it may bring meaning to some standard or it may be meaningless. Depending on what measures have been done to keep track of the process and quality, the PO measurement can ensure that the students produced have been included in the continuous quality improvement process and, therefore, by the very meaning of OBE, engineering students should be getting better from time to time. ■

REFERENCES:

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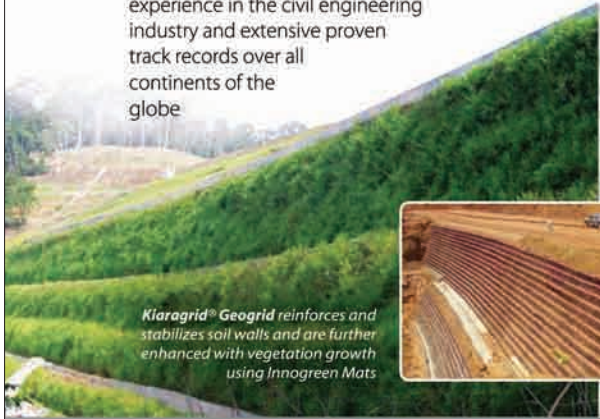


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