

Assessment Method for Course Outcome and Program Outcome in Outcome Based Education



by Ir. Zamri bin Mohamed

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, as well as the independence of the certification and credentials provided by the institutions of engineering education. "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" (EAC Manual 2007). From the EAC Manual, students of an engineering programme are expected to attain the following 10 program outcomes:

- 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. 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 is rather cumbersome and will take a lot of energy to keep track of students for every course at any given time. This has to be done continuously

for as long as the program is being accredited by the respective Engineering Accreditation Council as approved by the Washington Accord.

The guide by the accreditation is rather insufficient for any program owner to be confident of their assessment documentation. However, a method can be used to measure the achievement of course outcome in relation to the program outcome, which should meet the program's 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 this becomes the input for the cohort level assessment which takes into account all the courses taken by each cohort in any given semester. To ensure that the attainment is recorded, the course instructor needs to produce several forms and this will become the base for the next time when improvement needs to be done. The form will include the marks distribution and table for the course outcome attainment as well as table for the program outcome attainment.

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			

2. COURSE OUTCOME MAPPING TO PROGRAM OUTCOME

Course Outcomes from Fluid Mechanics 1 are taken as samples 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

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

3. 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, there are four questions for Test 1 (T1); Q1 and Q2 are to assess CO1, while Q3 and Q4 are for CO2 assessment. A similar case for Test 2 (T2) apply, two are designated to measure CO3 and another two for assessing CO4. In addition, 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' is to indicate whether each CO is achieved using value from column '% Total'. The last column represents 'Yes' or 'No'.

Table 2: Detail assessment planning

Course Outcome	Assesment				% 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 the mark that will indicate that the CO has been achieved. For example, an average number of 50 out of 100 may be chosen as the minimum level of mark 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 has been 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 only contribute 3% towards the overall final score. Q2 from Test 1 might only contribute 2%, 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

Table 3: Individual CO calculation

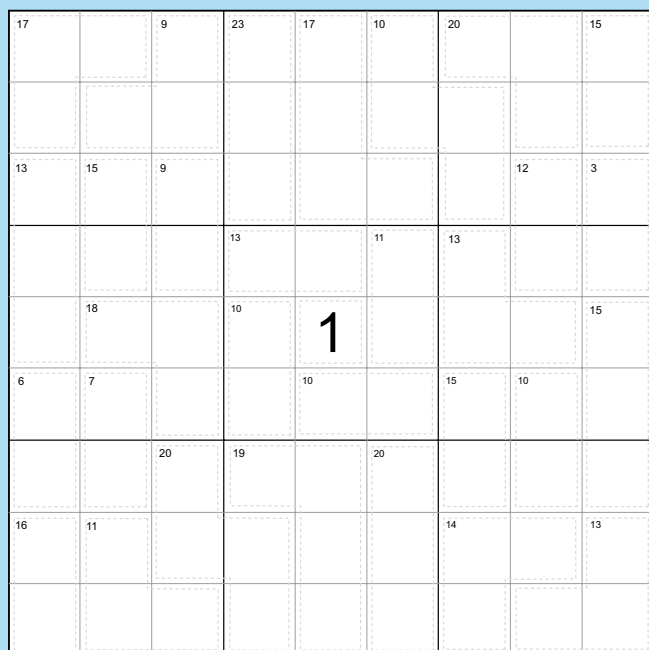
Student	CO1					Total (%)	CO Met (Y/N)
	Q1 (T1)	Q2 (T2)	Asgn 1	Asgn 2	Q1 (F.E)		
1. Ali	2	1	1	2	2	8	Y
2. Abu	0.5	0.5	1.5	2	2	6.5	N
3. Lai	1.3	1.5	1	1	5	9.8	Y
4. Raja	1.8	2	2	1	3	9.8	Y

able to say that CO1 has been achieved for any student, they need to get at least 7% so that it counts as 50% of the total possible score for CO1. A similar assessment needs to be done on other COs so that all COs are evaluated.

4. PROGRAM OUTCOME ATTAINMENT

Next, the achievement of the COs needs to be linked to the achievement of the POs or Program Outcome. To do this, value from Table 1 is used to calculate the score for PO. Table 4 shows the linkage from the COs to the POs. The 'CO Result' column shown below is 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.

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 the example in Table 4, CO1, CO3 and CO4 is met, therefore the weightage is calculated from the overall sum of the weightage for PO1. The bolded weightage represents the CO which has been achieved.



1SUDOKU

Centerpiece "2"

by Mr. Lim Teck Guan

About the puzzle:

In this Sudoku variant, only 1 number is given as clue, thus the name 1Sudoku. The rest of the clues are given in the numbered cages (the dotted frame encompassing 2 or more squares). You are to search for the right combinations to fit the total for the cages and end up with a Sudoku Grid, the 9 by 9 composite of squares where there is no repeat of the number 1 to 9 in every Row, Column or Block.

Fill in the remaining 80 squares with single digits 1-9 such that there is no repeat of the digit in every Row, Column and Block. The number at the top left hand corner of the dotted cage indicates the total for the digits that the cage encompasses.

For tips on solving, visit www.1sudoku.com.my

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Answer is in the following pages of this edition.

Table 4: PO attainment table

CO	PO	1	2	3	4	5	6	7	8	9	10
	CO Result										
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			

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 the partial contribution of one course towards the Program Outcomes. 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 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 4-year program, the program owner could get the overall PO Attainment for all semesters. Only this final PO Attainment (all semesters) can be considered as the Program Outcomes measurement for any cohort or entry.

5. CONCLUSION

By taking 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 finishes the program. After each cohort has completed the program, the overall PO Attainment can be used 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 carried out to keep track of the process and quality, 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 improving from time to time. ■

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