Outcome Based Education: A Case Base Approach

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Abstract: Accreditation providesqualityassuranceto an academic institution/programme. This encouragesan institution to move continuously towards the improvement of quality of its programme, and the pursuit of excellence. In this regards, this work provides the complete structure of the outcome base education with help of the case study. It also gives an insight how this accreditation is helpful to the stake holders (students, industries as well as institution itself)as well as for redesigning the curriculum in order to meet the international standard.

Keywords: Outcome Base Education, Programme Educational Outcome, Programme Outcome, Course Outcome, Stake holders, Programme Specific Outcome.

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1. Introduction

Outcome Based Education (OBE) means clearly focusing and organizing everything in an educational system. This means starting with a clear picture of what is important for students to be able to do, then organizing the curriculum, instruction, and assessment to make sure this learning ultimately happens. OBE is an approach for planning, delivering and evaluating instruction that requires administrators, teachers and students to focus their attention and efforts on the desired results of education. These results expressed in terms of individual student learning. This learning comprises of the knowledge, understanding, skills and attitudes that students should acquire for fulfilling the requirements at work. The aim of OBE is to develop coherent and understandable system because of the radical changes happened in the approach of engineering qualification since last two to three decades over the world particularly in USA and UK [1].

There are two approaches of accreditation. First one is the input - output based education.In this system measurable inputs are lab equipment's, infrastructures, faculty, students and the finance whereas number of graduating, their results, success rate and placements are the measurable outputs. However the second approach is OBEwhich is more focusing on the continuousimprovement of the entire education system which starts from the students learning outcomes and ends over the

Department of Mechanical Engineering ,K. J. Somaiya College of Engineering, Vidyavihar (East), Mumbai 400077.rameshlekurwale@somaiya.edu fulfilmentsof employer requirements. It is taking care of the opinions of all stake holders in order to enhance the quality of the education continuously. However, USA carries out two kinds of accreditation. They are institutional accreditation and programme accreditation similar to NAAC and NBA. In India, before 2013 there was an input - output based type of accreditation in practice whereas OBE come into force after January 2013 .

Thus, after considering the drawbacks of the input-output model of old accreditation system, the new assessment system has been proposed by National Board Accreditation (NBA) that is Outcome Based Education.The key constituents of OBE are Vision (V), Mission (M), Programme Educational Objectives (PEO), Program Outcomes (PO), Graduate Attributes (GA), Course Outcomes (CO), Mapping, Rubrics, Assessments, Evaluation and Grading [1,]. In this connection this paper presents an in-depth structure of OBE system with the live case of Production Planning and Control course of Semester VII of Mechanical Engineering programme.

In this article section 2 gives the methodology used in designing OBE. Section 3 presents how OBE helps in designing and modifying the curriculum.Section 4 presents the Process of Attainments of COs whereas section 5explains the implementation of OBE for one of the course in Mechanical Engineering. The paper ends with thediscussion and conclusion about the implementation of OBE dealt in section 6.

2. Methodology:

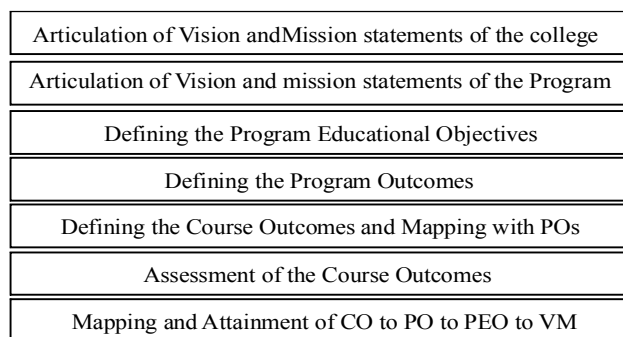Figure1. Present the methodology used in designing and implementation of outcome based education system.

Articulation of Vision andMission statements of the college
Articulation of Vision and mission statements of the Program
Defining the Program Educational Objectives
Defining the Program Outcomes
Defining the Course Outcomes and Mapping with POs
Assessment of the Course Outcomes
Mapping and Attainment of CO to PO to PEO to VM

Figure 1Methodology of OBE

3. Designing of Program Curriculum:

In the first cycleof accreditation institute will come to know where exactly the particular programme is lagging behind to satisfy employer requirements from the students. That lacuna might be related to inadequate infrastructure or may be designing of curriculum of the programme or may be teaching leaning methodology. Thus,for designing the curriculum of the programme, the mapping and attainment of CO to PO and PSO for each individual course will give the clear idea to identify the gaps in curriculum of the particular course.Figure: 2 gives the details about the attainment of PO using direct and indirect method. Secondly the analysis of PEOcan be done from the passed out batch after 4 years to identify the whether the programme objectives has been achieved or not. Then the consistency of PEO can be mapped with the mission of the department to check the fulfilment of mission of the department. Figure: 3presents how NBA will help designing the curriculum of the programme.
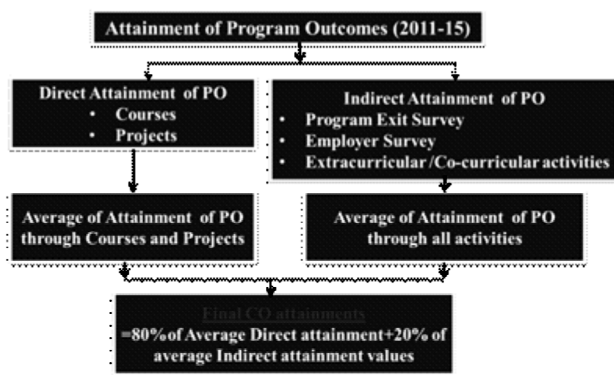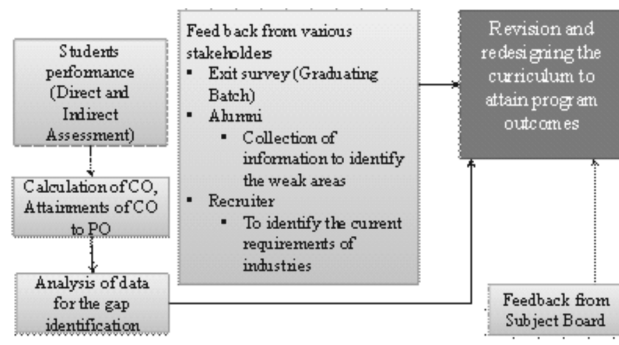

Figure 2 Attainment of PO

Figure 3 Curriculum design

4. Process of Assessment of COs

Following Process has been adopted for the evaluation of course outcomes:

a. Course coordinator defines the course outcomes for their respective course with reference to syllabus.

b. Attainment target of each CO is set for every course.

c. Correlation of these Course Outcomes with Program outcomes and their level of contribution are defined (Low- level 1, Medium - level 2 and High - level 3)

d. Deciding Assessment tools(Direct and Indirect)

Table 1 Assessment Tools

Exam No.	CO1(25)	CO2(25)	CO3(25)	CO4(25)

which is given in Table No. 1.

Table 2 Assessment Tools

Name of Item	Direct Assessments tool	Indirect Assessments tool
Courses	• End semester examination • Laboratory Experiment • Assignment • Term Test • Internal Assessment	Course exit survey
Project	• Presentation/oral • Report	Feedback from external examiners

e. Defining the Rubrics as an assessment tools to assess laboratory work, assignments, seminars etc. and informing these rubrics to the students at the beginning of the semester.

f. For calculation of attainment values of each COs 80% weightage are given to direct assessment and 20% weightage has been given to indirect assessment.

g. For evaluation of attainment, the Course COs are compared with the set target.

h. Level Mapping of CO to POs for each course has been carried out.

i. Average attainment values of each PO through all

the courses have been calculated to decide the level of attainment.

☐ Process of evaluation of Projects

a. Common Outcomes for all projects are defined.

b. Mapping of these Course Outcomes with Program outcomes and their level of contribution is defined.

c. In addition to these the mapping of specific projects with Program outcomes is also defined.

d. Based on the rubrics developed evaluation of the projects has been carried out.

e. Analysis of feedback collected from the external examiner of the project.

4.1 Methods of evaluations

There are two methods of evaluations. Direct Methods and indirect methods, which are explained in detailed in following section

Direct method evaluation
The tools for measurement of Cos achieved throughdirect methods are as follows

i) End Semester Examination examinations

ii) Laboratory and Assignment,

iii) Term Test

I) Measuring CO achievement through End Semester Examination (ESE) examinations and test papers

a) Question papersaredesign with due consideration for course outcomes as well as bloom taxonomy.

b) After assessment of answer papers the marks are entered in Table No. 2, into respective CO Column and COs are calculated and compared with the set target.

Table 2 Template for ESE CO Assessment

CO assessment (%) = (No of students scoring above the target set/Total number of student)× 100

c. If targets are achieved then all the course outcomes are attained for that year for the said course.

d. If targets are not achieved then plan of action is to be decided for next year.

II) Measuring CO achievement through Laboratory and Assignment

a. The tool for measurement of COs,for Laboratory Experiments, Assignments and Seminars are defined.
b. This assessment is done as per the defined rubrics.

Assessments ofLaboratory Experiments

The assessment is carried out through continuous evaluation during the semester and marks are entered in Table No.3 mentioned below.

Table 3 Continuous Assessment Sheet

Class: __ Semester: __Division: __ Batch: __ Sub:__Maximum Marks: ___Name of the Faculty: ___

Roll No.	Name	Expt./AssignNo./ Name		Expt./Assign.No ./Name	
		Marks	Date	Marks	Date

CO Assessment (%) ={[(No of students having marks between 9-10)× 3 + (No of students having marks between 7-8)× 2 + (No of students having marks less than 6)×1] / (Total students × 3)} × 100

⬜ Internal Assessment (IA)

IA can be assessed by conducting a Seminar, Assignments and Multiple- choice questions etc.Rubrics are defined for evaluation wherever required. For measurement of COs same method has been followed which is used for test paper and end semester examination.

4.1.2 Indirect Methods:

This method consists of evaluations feedback collected from various stake holders such as students, employer, parent etc.

i) Course Exit Feedback

a) At the end of the term a feedback (through Google form) is taken from all students registered for the said course.

b) Similar feedback is taken for Project also.

ii) Course Feedback Assessment:

In the course feedback form, each question is given a rating of 5-1 with highest rating 5.

CO assessment = [(No. of students with rating $5×5$ + No. of students with rating $4×4$ +No. of students with rating $3×2$ + No. of students with rating $2×2$) + No. of students with rating $1×1$/ (total students $×5$)]×100 %. Net Assessment in %= $0.8×D$ (Direct method)+$0.2×I$ (indirect method)

The Co attainment level is decided for the target level of 60%

Level- 1= CO assessment is less than 60%
Level -2 = CO assessment is 60to 69 %
Level -3 = CO assessment is above 70 %.

After discussion of the complete process of evaluation and attainment levels of COs, next section deals with case study of a course in mechanical engineering for in-depth exposure of the entire process of evaluation and attainment.

5. Case study:

A course,Production Planning and Control (PPC), semester-VII, of Mechanical Engineering Programme has been selected as a case to illustrate the complete structure of OBE. In this course, three COs has been defined with 60% target value and modes used to deliver the content are as follows

⬜ Blackboard Teaching
⬜ Visual Aid
⬜ Assignments
⬜ Seminars
⬜ Test
⬜ Case study

The mapping of the concern COs with the relevant POs has been decided which is given the following Table No.4. There are total twelve PO for the Mechanical Engineering programme, but only those PO which are mapped with the COs of this course PPC has been given Table 4. The average value of mapping of each PO with the all COs is calculated. For example PO1 is mapping with only one CO that is CO2. Thus the average value PO1mapping is = (0+3+0)/3 =1.

Table 4 Mapping of CO to PO

	PO1	PO2	PO3	PO5	PO11
CO1	-	-	-	-	3
CO2	3	-	2	-	-
CO3	-	3	-	1	-
Average	1	1	0.67	0.33	1

The CO assessment with direct and indirect tool has been carried out. Table no. 5 presents the assessment of all COs using direct tools. For indirect assessment the google questionnaire have been prepared and shared with all students registered for the said course. The summery of responses were noted which presented in Table No. 6. Table No.7 gives the overall attainment of all COs and their levels by considering the tools of both direct and indirect assessment. Atlast the overall contribution of each Course outcome of PPC course in Program Outcome has been evaluated (Table No. 8). The entire procedure explained earlier has been repeated for all the courses in the programme for the same batch (2011-15).To find the overall value of each PO, the average values of all PO by all courses given as 80% weightage and 20% weightage given to all co-curricular activities such as programme exit survey, internship, paper presentation, and extracurricular activities such as bloom box, sports etc. Thus, it gives overall attainment of programme outcome by all courses for the same batch. This calculations and relevant tables are not included in this paper but may be made available on request at any time.

Table 5 Assessment of Course Outcomes:

Course Outcome	Assessment Tool	Assessment (DivA+Div B) in%	Average Assessment
(Direct CO1 Methods)	Term Test - I	(89+91.28)/2 =90.14	76.34 t
	Assignment 1, 2	(62+70.5)/2 =65.25	
	End Semester Examination	73.62	
Cours CO2	Term Test – I & II	(72+75.35)/2 =73.67	66.17
	Assignment 3, 4	(59+65.5)/2 =62.25	
	End Semester Examination	62.58	
CO3	Term Test - II	(53+68.58)/2 =60.79	50.78
	Assignment 5, 6	(54+53)/2 =53.50	
	End Semester Examination	38.04	

Table 6 Assessment of Course Outcomes:

Course Outcome / Q No. (Indir		Questions for CO assessment ect Methods) Course	Assess-ment in % Exit	Average Assess-menti n %
CO1	1	Have you understood the concept of production planning and control?	90 surve	y 87
	2	Are you able to explain the organization of production planning and control system and its activities?	84	
CO2	1	Are you able to make computations for inventory management and forecasting problems?	Table 77	80
	2	Have you developed an understanding of product and process planning?	82	
CO3	1	Are you able to identify,formulateandsolvee ngineering problems related to resources allocation?	78	79
	2	Are you able to identify,formulate, andsolveengineering problems related to scheduling and sequencing?	80	

Table 7 Attainment of Course Outcomes

CO	Assessment in %		Average Assessment	Target Set	Attainment Level *
	Direct (D)	Indirect (I)	(0.8*D+0.2*I)		
CO1	76.34	87	(76.34 x 0.80) + (87 x 0.20) =	-	78.47 (3)
CO2	66.17	80	(66.17x 0.80) + (80 x 0.20) =	60%	68.94 (2)
CO3	50.78	79	(50.78 x 0.80) + (79 x 0.20) =	60%	56.42 (1)

Table 8 Contribution of Course outcome in Program Outcome Attainment

	PO1	PO2	PO3	PO5	PO11
CO1					3
CO2	2		2		
CO3		1		1	
Average	0.67	0.33	0.67	0.33	1

6. Discussion and conclusion:

Thus, from the above Table No 8 it is very clear that only PO11,PO3 and PO5 has attained fully. This indicated that the CO1 has been fully satisfied andCO2 and CO3 satisfied partially. Other POs such as PO1, PO2, represents some gap in curriculum which needs to be address on priority basis. Out of the two POs mentioned above major improvement is in curriculum which are associated with CO3 mapped with PO2 is to be addressed on top priority. From Table No. 7 it clear that CO3 assessment is very low by direct tool. Thus, there is a need to make some changes in teaching learning (extra lecture/add more test/Tutorials) method of the concern topic in the syllabus. Secondly, CO2 relates inventory management, forecasting and process planning. In order to increase the percentage assessment of CO2 by direct tool students should be given more tasks on these topics.

In this way OBE helps in identifying the gaps in the curriculum to meet the learning objectives to suit the industry requirements. In future the suggestions given in the last paragraph can be implemented for the same course in the next academic year which will definitely gives the enhance level of PO attainments.

Acknowledgement

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