

Course Outcome and Programme Outcome in OBE: An Illustration in Engineering and Technology

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Abstract

In NBA process of accreditation, OBE should fulfil the one of most important criteria such as attainment of Course Outcomes (COs') and Program Outcomes (POs'). In general we have direct and indirect assessment tools for the purpose of CO and PO attainment. The direct assessment tools can be Continuous Internal Evaluation – 1 (CIE – 1), Continuous Internal Evaluation – 2 (CIE – 2) and End Semester Examination. Indirect tools can be Assignment or Quiz, Seminar or Group Seminar or Tutorial or Mini Project or Project Based Learning or Peer-to-Peer Learning. We have considered File Structures as a sample course and a set of COs have been defined along with the PO attainment planned. We have a detailed assessment scheme and plan of execution where students are participating in different assessments methods which includes both direct and indirect assessments. We have calculated CIE, Assignment and Seminar, SEE performance analysis. The Overall CO Attainment Level is calculated by using the formula $(E=C \times 0.7 + D \times 0.3)$ where C is Internal and D is external attainment level. Finally, we are considering the feedback from the students through Course Exit survey, where we are understanding the course outcomes module-wise in the student perspective and final PO attainment is calculated for each Course Outcome.

Keywords: Outcome Based Education, Continuous Internal Evaluation, Performance Analysis, Course Outcome, Programme Outcome, CO Attainment, Course Exit Survey, PO Attainment.

1. Introduction

To incorporate quality in technical Institutions, Government of India mandated the process of accreditation. In this view, National Board of Accreditation (NBA) plays a vital role for the process of accreditation. India has become permanent member of Washington Accord since 13 June, 2014 and this board instructed, technical institutions need to follow Outcome Based Education (OBE). In this process of accreditation, OBE should fulfil the one of most important criteria such as attainment of Course Outcomes (COs') and Program Outcomes (POs'). The POs designed and formulated for each programme by the Institute must be precise such as Engineering Knowledge, Problem Analysis, Design or Development of Solutions, Conduct Investigation on Complex Problems, Modern Tool Usage, The Engineer and Society, Environment and Sustainability, Ethics, Individual and Team Work, Communication, Project Management and Life-long Learning. The design and formulation of COs is done through the instructor and choice of the course or subject of consideration. These POs can be attained through the COs.

2. Assessment Techniques

As we know already, in general we have direct and indirect assessment tools for the purpose of CO and PO attainment. The direct assessment tools can be Continuous Internal Evaluation – 1 (CIE – 1), Continuous Internal Evaluation – 2 (CIE – 2) and End Semester Examination. Indirect tools can be Assignment or Quiz, Seminar or Group Seminar or Tutorial or Mini Project or Project Based Learning or Peer-to-Peer Learning.

Table – 1 summarizes the tools to be used for assessment and attainment of COs and POs. As per the university (Visvesvaraya Technological University – VTU) curriculum, we designed this kind of direct,

indirect assessment tools to evaluate the overall attainment of the course which includes both CO and PO. Based on the modules, instructor designed the CO and their allotted PO mapping (High / Medium / Low).

Direct Tools	Weightage Provided	Indirect Tools	Weightage Provided
Continuous Internal Evaluation (CIE's)	20% - 30%	Assignment	5% - 10%
End Semester Examination	50% - 60%	Quiz	5% - 10%
		Seminar / Group Seminar	5% - 10%
		Tutorial	5% - 10%
		Minor Project / Project Based Learning	5% - 10%
		Peer-To-Peer Learning	5% - 10%
		Course Exit Survey	5% - 10%

Table – 1: Direct and Indirect Tools Used

3. Sample Course – File Structures

We have considered the sample course namely, File Structures (FS), which is being offered in the sixth

semester CS streams. We have considered the class of 61 students and designed a set of COs have been defined along with the PO attainment planned and it blooms taxonomy level.

A. Designing Course Outcomes

CO No.	Description	Bloom's Level	Attainment Planned
C319.1	Choose appropriate file structure for storage representation and their mechanism to store different types of files.	CL2	60%
C319.2	Organizing files using object oriented concepts and retrieve the same using advanced concepts like inverted lists, selective indexes.	CL2	60%
C319.3	Identify a suitable sorting techniques to arrange the data and use of multi-level indexing and B-tree techniques for organization of data in a file.	CL3	60%
C319.4	Select suitable indexing and hashing technique for better performance to a given problem.	CL3	60%
C319.5	Choose some advanced file storage structures like Extendible hashing for better performance.	CL4	60%

Table – 2: List of Course Outcomes

Table 2 provides the course outcome for the sample course considered in this article and we have shown the Bloom's level with their target attainment. We have drafted the course outcomes based on the curriculum given in the university [1]. We had five modules in the sample course considered and for the every module we drafted a specific course outcome.

B. Course Outcome Mapping with Programme Outcomes

CO No.	Programme Outcomes (POs)											
	1	2	3	4	5	6	7	8	9	10	11	12
C319.1	3	2	3	2	2	1	1	2	1	-	2	2
C319.2	3	2	3	2	2	1	2	2	2	-	3	2
C319.3	3	3	3	3	2	2	3	2	3	-	3	3
C319.4	3	3	3	3	2	2	3	2	3	1	3	3
C319.5	3	3	3	3	2	2	3	2	3	1	3	3

Table – 3: COs – POs – PSOs – Mapping

We had a programme outcomes which was drafted from the NBA board [2], and the same POs are mapped in every course outcomes by providing the values such as 3 – High, 2 – Medium and 1 – Low.

These values are assigned based on the marks of the each COs for each student. The values are assigned based on the each module or unit importance, significance of the different concepts available.

C. Evaluation Scheme

Continuous Internal Evaluation Scheme:

Name of the Assessment	Method of Assessment	Maximum Marks Allotted
CIE – 1	Direct (Test)	30
CIE – 2	Direct (Test)	30
CIE – 3	Direct (Test)	30
(Average of CIE – 1, 2, 3) Total		30
Assignment – 1 / Quiz – 1	Indirect	05
Peer-to-Peer Learning / Seminar	Indirect	05
Total		40

End Semester Examination Scheme:

Name of the Assessment	Method of Assessment	Maximum Marks Allotted	Weightage in Marks
End Semester Examination	Direct (Examination)	100	60
Total			60

Table – 4: Consolidated Evaluation (CIE + End Semester Exam = 40 + 60 = 100 Marks)

Table 4 provides the detailed assessment scheme and plan of execution where students are participating in different assessments methods which includes both direct and indirect assessments. This plan of assessment gives the split of overall marks into different parts of the evaluation such as CIE,

Assignment, Quiz, Seminar etc., and finally the end semester examination. Finally, we are considering the feedback from the students, where we are understanding the course outcomes module-wise in the student perspective.

D. CIE Performance Analysis

In the CIE – 1, there will be four questions, two from first two modules. Students need to answer one question from each module. Each questions holds 15 marks and CIE – 1 covers first two course outcomes.

Table – 5 provides the performance analysis of CIE – 1. This analysis demonstrates that the average attainment of course outcome C319.1 has 79.18% and C319.2 has 72.81%.

Question No.	CO Mapped	Students Attempted	Average Marks	Percentage of Score
1	1	34	13	87%
2	1	24	10.5	70%
3	2	22	11	73%
4	2	34	12.5	83%

Table – 5: CIE – 1 Performance Analysis

Similarly table – 6 provides the performance analysis of CIE – 2 and this constitutes second (some parts the CO are unattained) and third course outcome. This

analysis demonstrates that the average attainment of course outcome C319.2 has 67.82% and C319.3 has 64.40%.

Question No.	CO Mapped	Students Attempted	Average Marks	Percentage of Score
1	2	37	14	93%
2	2	17	12.5	83%
3	3	31	12	80%
4	3	27	11.5	77%

Table – 6: CIE – 2 Performance Analysis

Similarly, table – 7 provides the performance analysis of CIE – 3 and this constitutes fourth and fifth course outcome. This analysis demonstrates that the average

attainment of course outcome C319.4 has 64.64% and C319.5 has 68%.

Question No.	CO Mapped	Students Attempted	Average Marks	Percentage of Score
1	4	31	13	87%
2	4	15	11.5	77%
3	5	40	14.5	97%
4	5	05	11.5	77%

Table – 7: CIE – 3 Performance Analysis

E. Assignment and Seminar Performance Analysis

We have given assignment questions from module – 1 & 2 and seminar (peer-to-peer learning) concepts from module – 3, 4 & 5. We are planned to cover attain in all the course outcomes, since the end semester examination doesn't contain any CO and PO mapping. Because this curriculum is designed by the university for the partial fulfilment of undergraduate Bachelor of

Engineering course in Information Science and Engineering (ISE). This is the behind that, the attainment calculation for all the CO and PO which is considered in assignment and seminar.

Name of the Assignment	CO Mapped	Students Attempted	Average Marks	Percentage of Score	COs Attainment
Assignment – 1	1	61	4.5	90%	34.90%
Assignment – 1	2	61	4.5	90%	26.44%
Seminar	3	61	4	80%	31.94%
Seminar	4	61	4.5	90%	27.24%
Seminar	5	61	4.25	85%	34.56%

Table – 8: Assignment and Seminar Performance Analysis

F. End Semester Examination Performance Analysis

End semester examination question paper has been designed by the university expert professors, which doesn't contain any CO mapping and PO mapping as well. Since this shows that, there is no attainment level at the end of semester examinations. But, we have calculated the pass percentage level based on their

marks in the examination and the same has been considered for the final attainment. Pass percentage includes first class, second class, pass and fail. For the above considered course File Structures we got the overall percentage as 47.72% after the end semester examinations.

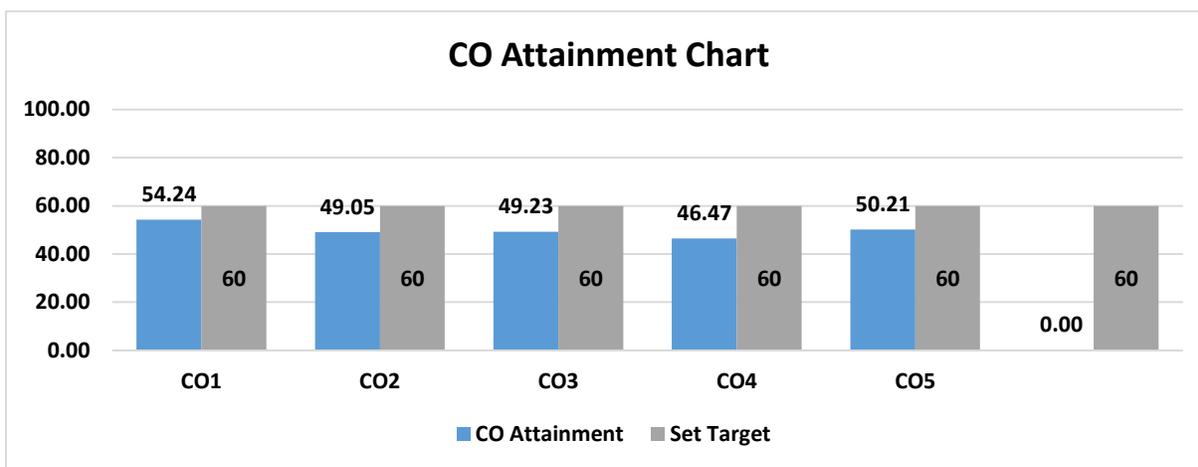


Fig 1: Course Outcome Attainment Chart

Figure 1 and table – 9 provides the course outcome attainment which includes direct and indirect attainment of the course.

COs	*Assigned Target Level	Direct Tool Attainment Level (A)	** Indirect Tool Attainment Level (B)	Internal Overall Attainment Level (C= (A+B)/2)	*** External Examination Attainment Level (D)	Overall Attainment Level (E=C×0.7+D×0.3)
C319.1	60.00%	79.18	34.90	57.04	47.72%	54.24
C319.2		72.81	26.44	49.63		49.05
C319.3		67.82	31.94	49.88		49.23
C319.4		64.64	27.24	45.94		46.47
C319.5		68.00	34.56	51.28		50.21

Table – 9: Final CO Attainment

G. Course Exit Survey

The course exit survey has been taken from the students, where the survey contains all the course outcomes and the students will rate their understanding level of attainment as Excellent-5, Good-4, Average-3, Below Average-2 and Poor-1.

Course Exit Survey Analysis					
	C319.1	C319.2	C319.3	C319.4	C319.5

Option 1	1	2	1	1	1
Option 2	2	1	2	1	2
Option 3	12	14	10	9	10
Option 4	15	15	18	19	11
Option 5	35	35	38	35	36
Total no. of students	65	67	69	65	60
No. of students opted 3 and high	62	64	66	63	57
% of students opted 3 and high	95.38%	95.52%	95.65%	96.92%	95.00%
Attainment Level	5	5	5	5	5

Table – 10: Course Exit Survey

Table – 10 provides the detailed course exit survey of the above mentioned course. This can be computed based on the understanding of the every COs in the perception of students. Every student is rating the every CO through the values ranging from 1 to 5,

where 5 is the highest score for the CO and 1 is the least score for the CO. Likewise, we are taking the survey for all COs, and calculating the survey based on their understanding and its value assignments.

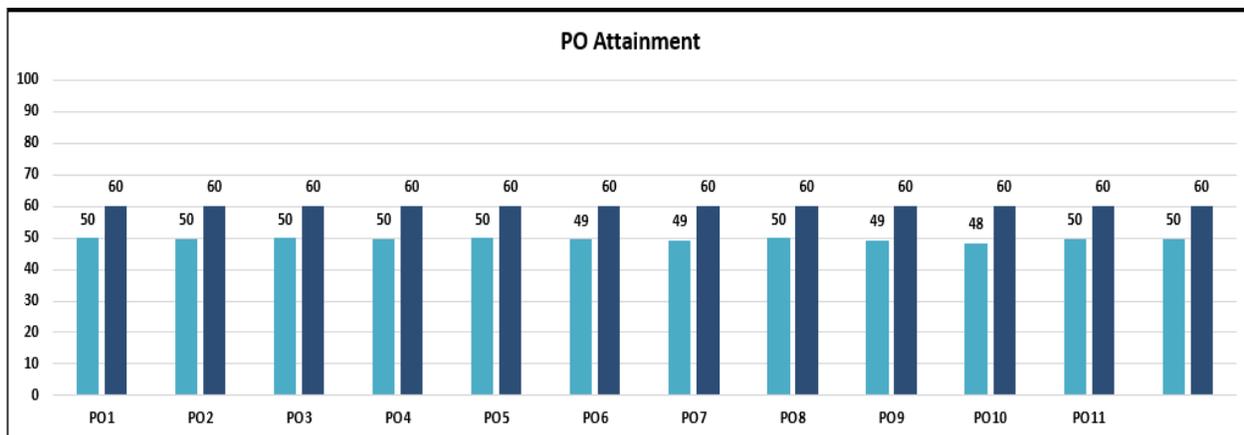


Fig 2: Programme Outcome Attainment Chart

Figure – 2 and table – 11 provides the programme outcome for the proposed course outcome in the sample course File Structures.

CO No.	Programme Outcomes (POs)											
	1	2	3	4	5	6	7	8	9	10	11	12
C319.1	1.63	1.08	1.63	1.08	1.08	0.54	0.54	1.08	0.54	-	1.08	1.08
C319.2	1.47	0.98	1.47	0.98	0.98	0.49	0.98	0.98	0.98	-	1.47	0.98

C319.3	1.48	1.48	1.48	1.48	0.98	0.98	1.48	0.98	1.48	-	1.48	1.48
C319.4	1.39	1.39	1.39	1.39	0.93	0.93	1.39	0.93	1.39	0.46	1.39	1.39
C319.5	1.51	1.51	1.51	1.51	1.00	1.00	1.51	1.00	1.51	0.50	1.51	1.51

Table – 11: Final PO Attainment

Table – 12 provides the overall result analysis for the sample course File Structure which includes the CIE

final marks and end semester examination marks as well, which the overall result for the sample course.

Analysis						
Range	CIE-1 (30)	CIE-2 (30)	CIE-3 (30)	CIE (40)	External (60) Number of Students	Total (100)
<60%	12	15	16	8	36	22
>=60% and <=70%	11	19	13	7	17	23
>70%	33	22	26	40	2	10
Maximum	30	29	30	39	48	84
Minimum	9	0	5	18	3	24
Mean	21.98	19.71	20.24	30.11	31.24	61.51

Table – 12: Overall Result Analysis

4. Conclusion and Future Scope

In this article, we have considered a real time data for analyzing the attainment of Course Outcomes and Programme Outcomes. These are evident that the actual attainment of the Course Outcomes and Programme Outcomes are meeting the planned expectations. The direct and indirect tools used for the assessment and their weightages can be suitably selected as per the requirement of the Institute. In further, we are planning to have a provision to design the end semester examination which includes the course outcome mapping and programme outcome mapping. This will automatically boost-up the attainment level in direct and indirect assessments tools and by default it can increase the attainment level at the end of semester examinations. Based on the course exit survey taken from the students, we are planning to incorporate the feedback given and we will focus on the less attainment course outcome and taking necessary action plan for the next academic year in the same sample course.

In initial academic year, we have chosen the attainment level as 60%, since the sample course has been designed drafted with COs and POs attainment values. Once we reached the above mentioned attainment level, we are planning to attain more in the subsequent academic year such as 70% and so on. This will automatically boost-up the students understanding level in the sample course, and he or she

will nurture the depth knowledge of the course, which helps in placement activities and higher studies.

References

- [1] www.vtu.ac.in/pdf/cbcs/38sem2019/isesyll.pdf (Visvesvaraya Technological University Website).
- [2] www.nbaind.org (National Board of Accreditation Website).
- [3] https://en.wikipedia.org/wiki/Outcome-based_education