Course and Programme Outcomes Attainment Calculation of Under Graduate Level Engineering Programme Using Deep Learning

S. Manikandan, P. Immaculate Rexi Jenifer, V. Vivekanandhan, and T. Kalai Selvi

Abstract Outcome-based education (OBE) is playing important role for producing successful engineering graduates. OBE provides an engineering graduates that are employable and accepting their graduation as globally competent. After end of the graduation, this outcome-based education will enable graduates to compete the global market. This paper gives course outcome (COs), programme outcome (POs) and programme-specific outcome (PSOs) attainment calculation of under graduate level engineering course. Here, we are taking cloud infrastructure and computing core course for B. Tech Information Technology programme. This paper explains detailed view of course plan, knowledge levels, delivery methods and assessment. The direct and indirect methods are used for assessment and attainment process. At the end, based on attainment results, we find the graduates level and programme outcome attained or not. The course end reflective report provides information about course attained or not. Also, this end report will be used for next academic year course input. At the end of this paper, we can easily track the performance and attainment of POs and PSOs.

Keywords Outcome-based education · Course outcomes · Programme outcomes · Programme-specific outcomes · Attainment

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1 Introduction

India started to implement outcome-based education in all the higher educational institution and signed memorandum of understanding between Washington Accord and National Board of Accreditation of improving graduating attributes quality. Current graduates need to compete with global standard, so outcome-based education system is mandatory requirements. Assessment is most important factor for implementing OBE. The overall attainment is calculated by using programme educational objectives (PEOs), programme outcomes (POs), programme-specific outcomes (PSOs) and course outcomes (COs). PEOs attainment is calculated after graduation after four year how the graduates are there in the society or they are globally competent or not [1, 2].

POs and PSOs attainments are calculated after graduations. Course outcomes attainment is calculated at each semester end of the courses. Course outcomes attainment is very important factor calculating POs and PSOs. POs are taken from graduates attributes (GAs). The GAs for under graduate engineering programme are given by NBA, so we are using as the same. Also, AICTE current exam reforms policies performance indicators are also measuring competencies [1].

Programme-specific outcomes are specific to the undergraduate programme. Direct and indirect assessment tools are used for measuring the attainment of course outcomes. Direct attainment tools are continuous assessment test, end semester examination, assignments, case studies, technical seminar, etc. The indirect assessment tools are surveys, feedbacks, etc. Course end survey is collected at end of each course and that will be considered for CO attainment. Alumni, employer and graduate exit survey is used for calculating POs and PSOs attainment [3].

In this paper, we used B.Tech Information Technology Programme Outcomes, programme-specific outcomes and performance indicator of E.G.S. Pillay Engineering College, Nagapattinam. Cloud infrastructure and computing course is taken for course attainment calculation. This paper discusses course outcomes mapping with POs and PSOs, course end survey, assessment questions mapping and attainment calculations.

2 Course Outcomes, Programme Outcomes and Programme-Specific Outcomes

Course outcomes are narrow statement which gives end of this course student will be able to develop knowledge, skill and attitude of that course. Course outcomes are mapped with programme outcomes and programme-specific outcomes (Table 2) [4, 5]. The below table (Table 1) shows that course outcomes for cloud infrastructure and computing course offered for seventh semester B.Tech Information Technology.

The cognitive levels are knowledge levels taken from revised blooms taxonomy which can be achieved by using test [6], assignments [7], tutorials [8], case studies [9],

Table 1 Course outcomes competency and cognitive levels

	Competency	Cognitive level
CO1	Develop cloud computing architecture, infrastructure and delivery models using various cloud services	Apply
CO2	Build virtual machines using their types, tools and operations at storage, network and compute levels	Apply
CO3	Deploy virtual machines using various cloud platforms	Analysis
CO4	Deploy various programming model to implement cloud infrastructure and platform	Analysis
CO5	Build the appropriate cloud security services to implement real-time cloud models	Apply

mini-projects, activities, events [10], etc. Remembering, understanding and apply are lower order thinking skills (Table 1). Analysis, evaluate and create are higher order thinking skills. The programme outcomes and programme-specific outcomes are taken from AICTE reference [11, 12]. Support provided by COs to Pos/PSOs: L = lightly(1); M = Moderately(2); S = Substantially(3).

3 Course Plan, Delivery and Assessment Method

In this section, we discussed course plan, delivery method and assessment method for cloud infrastructure and computing course. Course is also called lecture plan which gives information about topic, number of hours and teaching methods [13, 14]. We give information each topic targeting which course outcomes also mentioned. Table 3 shows lecture plan and delivery methods. In below, course outcome-wise topics and number hours are mentioned. Each course outcomes are taken, and delivery and assessment methods are shown in below.

Also, each topic teaching methods are given. Each module completion number of lecture hours, tutorial hours, and laboratory hours are mentioned. This course is tutorial-based course, so total teaching hour is 60 and credit is 4 (Lecture: 3, Tutorial: 1). So, faculty members and students can easily understand what kind knowledge, skill and competency to each topic. Also, they get clear view about assessment and evaluation.

4 Attainment Calculation—Process

Direct methods display the student's knowledge and skills from their performance in the continuous assessment tests, end-semester examinations, presentations, classroom assignments, etc. (Table 4). These methods provide a sampling of what students

Table 2 Course outcomes to PO and PSO mapping

Comp	POI	PO2	PO3	PO4	PO5	PO6	PO7	POS	PO9	P10	POII	PO12	PSO 1	PSO 2	PSO 3
CO1	3	2	2	1	2	–	–	–	–	–	–	–	3	2	1
CO2	3	2	2	1	2	–	–	–	–	–	–	–	3	2	1
CO3	3	2	2	1	2	1	–	–	–	–	–	–	3	3	2
CO4	3	2	2	1	2	1	–	–	–	–	–	–	3	3	2
CO5	3	2	2	1	2	1	–	–	–	–	–	–	3	3	2

Table 3 Lecture plan and delivery methods

CO	Level	Delivery method
CO1	Apply	Lecture with discussion and lab—problem solving
CO2	Apply	Lecture with discussion and lab—problem solving
CO3	Analysis	Tutorial, lab and case study—problem solving
CO4	Analysis	Tutorial, lab and assignment—problem solving and collaborative
CO5	Apply	Tutorial, lab and case study—problem solving and project-based learning

Table 4 Assessment pattern

THEORY COURSES	
Direct assessment—CAT and end semester	
Continuous assessment	40
Distribution of marks for CA: *Test I (10)* *Test II (10)* *Test III (10)* *Activity 1 (5)—tutorial* *Activity 2 (5)—case study*	
End semester examination	60
Total marks	100
Indirect assessment: course end survey	

know and/or can do and provide strong evidence of student learning. Direct assessment method: using measurable performance indicators of student. Test, Assignments, Tutorials, Laboratory Test and Project marks are taken for final attainment calculations.

The attainment levels are explicitly shown to the students by virtue of correlation and the average performance levels in the university examinations and the student's performance in internal assessment; it is enlightened that the performance in careful internal assessment would upgrade and excel their performance in the end semester examinations. The attainment calculations are shown in below. In this Fig. 1 shows that the examination marks are mapped with each course outcomes.

The course outcome attainment is calculated by using direct and indirect assessment method. For direct assessment we used continuous assessment test marks, End semester marks, assignment, open book test, case studies, laboratory experiments marks and Indirect assessment Course end survey (at the end of each semester feedback is collected from student). Each questions mark is mapped with course outcomes, and total mark is calculated for each COs. The CO target is calculated by using previous academic year course attainment percentages. For cloud computing course, target is fixed; 70% means previous 3 academic years; this course average percentage is 60% to 70%. The students' performance is calculated for each students, and percentage is obtained those who are all got above the target percentages.

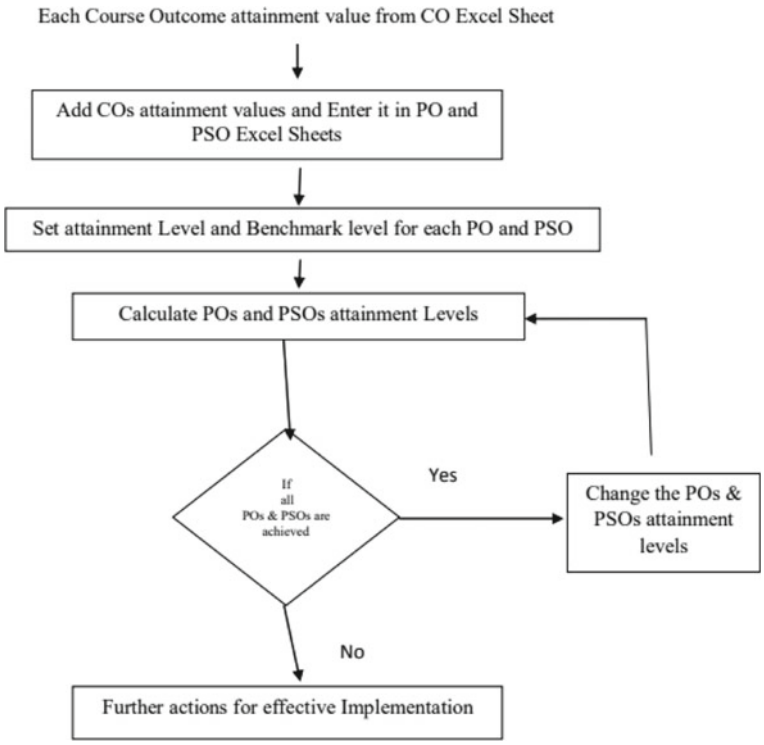

Fig. 1 Attainment process

Fig. 2 shows attainment results of course outcome wise. Here, the number of students attended for cloud infrastructure and computing course is 60, and attainment target is 70%. The course outcome benchmark is calculated from number of questions asked in test, assignments, lab experiments, etc. For the calculation number students are got 70% and above in each course outcomes taken and obtain the attainment. From the above course end reflective report said that CO2, CO3 and CO5 are above 70% so level is 3 and CO1 and CO4 60–69% so the level is 2. If level is below 1 means that course outcome is not attainment, so in next academic year further action or implementation is required. All the course outcomes are achieved means same process will be continued next academic years.

The PO and PSO attainment marks are taken from questions mark sheet. The highest knowledge levels are only taken into PO and PSO attainment calculations. Each performance indicators are marked in highest level questions and that can be used for attainment process.

Fig. 3 shows cloud infrastructure and computing course PO and PSO attainment. The marks are taken from highest knowledge level questions. Target is fixed 70%, PO1, PO2, PO5, PSO1, PSO2 and PSO3 are above 70%, and PO3 and PO4 are 60%. The process will be followed for all the courses. Here, PO and PSO attainment is

		Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16
	Questions with Couse Outcomes	1	1	2	2	3	3	4	4	5	5	1	2	3	4	5	5
	Max Marks	2	2	2	2	2	2	2	2	2	2	12	12	12	12	12	20
	PO/PSO - PI																1.7.1 2.6.2 3.6.2 4.4.2 5.5.1 5.5.2 / 1.2.1 2.2.1 3.2.1
Reg.No	Name of the Student																
E17ITR001	ABIRAMI.D	2	2	2	2	1	2	2	0	2	1	12	10	12	10	11	20
E17ITR002	AKASH.B	2	1	2	1	0	1	1	2	1	1	6	7	3	0	12	20
E17ITR003	AKASH.P	2	1	1	0	0	1	1	1	1	0	5	5	8	4	0	18
E17ITR004	AKASH.S	2	1	2	1	2	1	0	1	1	1	8	11	10	10	0	16
E17ITR005	ANANTHI.A	2	1	2	1	1	0	0	1	2	0	10	10	10	0	4	15
E17ITR006	ANUSUYA.N	2	2	2	1	2	2	1	2	1	0	6	2	0	7	10	18
E17ITR007	ARIVAZHAGAN.S	2	2	2	1	2	2	2	2	2	8	3	11	10	9	0	16
E17ITR008	AROCKIA STEPHAN RAJ.A	2	1	2	2	2	2	1	1	1	2	10	8	10	10	7	20
E17ITR009	ARTHI.K	2	2	2	2	2	1	1	2	2	2	2	2	3	0	11	20
E17ITR010	ARUNA.B	2	2	2	1	1	1	0	2	2	2	12	12	12	8	12	20
E17ITR011	ASFAR.FATHIMA	2	2	2	2	2	1	2	0	1	1	10	12	12	8	12	17
E17ITR012	ASIKA.M	2	1	2	1	1	0	1	0	0	0	11	10	12	12	9	18
E17ITR013	ATCHAYA.A	2	2	2	1	2	1	2	2	2	2	10	10	8	10	10	18
E17ITR014	BHARATH.P	2	1	2	1	0	0	0	0	0	1	5	2	2	3	0	10
E17ITR015	CHANDRALEKA.C	2	1	1	0	2	2	2	2	2	2	10	12	12	12	8	20
E17ITR017	DHARANI.J	2	1	2	2	2	2	2	2	2	0	10	10	12	12	8	17
E17ITR018	DHARANI.R	2	1	2	2	2	2	1	2	1	1	12	11	10	12	12	20

Course Attainment						
Target (Marks) %		70	70	70	70	70
Target (No. Of students) %		60	60	60	60	60
No. of students who got the above benchmark in Assesment		39	51	50	35	49
% of Attainment in Assessment		65	85	83	58	82
% of Attainment Course End Survey (Indirect Assessment)		89	85	95	98	90
Course Attainment		66.2	85	83.6	60	82.4
		2	3	3	2	3
above 70%	3					
60-69%	2					
50-59%	1					
below 50%	not attained					

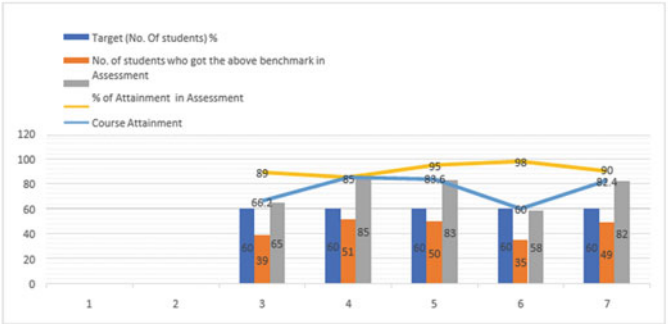

Fig. 2 CO attainment results

given as sample only. End of the programme all the courses and surveys are required for attainment calculations.

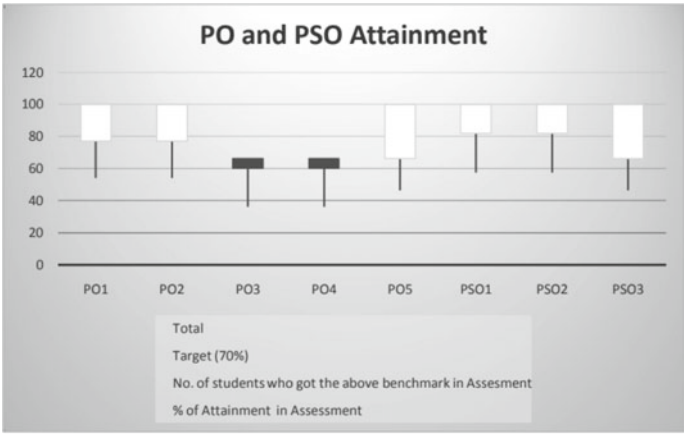

Fig. 3 PO and PSO attainment

5 Conclusion

This paper provides insight about course outcomes attainment calculations using detailed lecture plan and assessment methods. Each course outcomes are tested by using different assessment methods. All the questions and test items are mapped with COs and knowledge levels. So, target is fixed for each course, and attainment is obtained by using students' performance. Using performance indicators, PO and PSO attainments are calculated. After the CO attainment course end reflective report is prepared, and it is the input for next academic year handling the same course. Based on this, we will change assessment pattern and delivery methods. So, we can easily track the students' knowledge and competency.

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Multilayer Communication-Based Controller Design for Smart Warehouse Testbed

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Abstract Regarding a smart warehouse, building an industrial control system (ICS) that works effectively with the requirements is essential. An ICS, on the other hand, is a broad category of command and control networks and systems that support a wide range of industrial processes. They include SCADA systems, distributed control systems (DCS), process control systems (PCS), safety control systems (SIS), and

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