

An Effective Tool For The Attainment of Course Outcome's and Programme Outcome's

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Abstract— The Outcome Based Education (OBE) has been one of the major concern of most academic institutions in India, especially among engineering colleges since the National Board of Accreditation (NBA) has made it compulsory towards program accreditation. However, the concept of OBE resulted to various attainment to Programme Outcome (PO) based on the Course Outcome (CO). Execution of the OBE may not be an easy matter as the mapping of the CO for each assessment may be mapped to multiple PO. This paper describe the analysis process of the CO and PO attainment for Design and Analysis of Algorithms subject, which is offered to 2nd year students of Computer Science and Engineering, SR Engineering College, Warangal. Two methods are incorporated, (1) direct measurement, and (2) segregated measurement. The study identified that segregated measurement are more sensitive towards identifying the issues which affect attainment of CO and PO. Issues related to non-fulfillment of either CO or PO for Design and Analysis of Algorithms subject can be traced to lack of awareness towards Problem Analysis and Complexity of Algorithms and student's attitude towards subject knowledge.

Keywords—Outcome Based Education, Course Outcome, Programme Outcome, Engineering Education

1. Introduction

The implementation of Outcome Based Education (OBE) has been among the main focus of academic institution in India, especially among engineering colleges. India is permanent member of the Washington Accord through the National Board of Accreditation (NBA) in 2014 [1]. NBA has made OBE implementation as a compulsory practice in order for the institution to attain accreditation for all cohorts. The implementation of OBE is intended to ensure the curricula design fulfils the programme outcome and programme education objective, which shall reflect the achievement to the college's mission and vision. The concept of OBE is about developing the curricular structure based on what the learner are expected to achieve at the end of the education programme [2].

The direction towards OBE implementation has been supported by most academic institution which offers engineering courses in India [3]–[9]. Various education models have been highlighted in support towards OBE implementation [1], [10]. The emphasis of OBE is able to produce the human capital needs as required by the industry based on the feedback obtained from the stakeholders [3]. It was proposed that effective OBE implementation requires the institution to totally replace their curriculum framework and develop new structure that reflects the intended outcome [2]. However, restructuring existing curriculum requires in-depth considerations and a very time consuming process. Added to the fact

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that the NBA will visit the academic institution once every two-years or periodically, changing the entire curriculum. Thus, to start everything from scratch may not be a feasible option among the academic members.

Also, the understanding of OBE itself varies among academic institution [2]. The OBE implementation is often regarded as compliance-driven instead of performance-driven activity. The execution seems very structured on paper, but the implementation may involve daunting data collection process which resulted to lack of commitment among academic members in ensuring the success of OBE implementation. Among the issues pertaining to Programme Education Objective (PEO) and Programme Outcome (PO) may be associated to varying attainment method due to different understandings of course coordinator. There is no common ground of understanding with regard to determining the percentage of achievement. Some may only determine the course achievements based on final exams only, some may only consider selected questions in the assessment, and some other may consider all assessments.

In addition, the execution of OBE may not be an easy matter as the mapping of Course Outcome (CO) to PO may not necessarily be mapped to one item only. One CO may be mapped to multiple PO which resulted to further confusion with regard to the attainment calculations.

Thus, the real issues to the curricula structure could not be brought forward due to the varying assessment measurement. In OBE assessment measures are divided into two broad categories direct and indirect or segregated measurements. The Direct measures have a distinct advantage over segregated because they allow us to concentrate on what students have learned or failed to learn. Departments can use this information to highlight their strengths. And when weaknesses are found, faculty can explore causes, over which they have control, and develop solutions. Still, both kinds of measures are imperfect. Direct measures will not provide any evidence as why the student has learned or why he or she has not learned. Indirect measures are based on perceptions that can be subjective. The best kind of program or department assessment makes use of both kinds of measures. In addition, it may result to significant differences that affect the actual attainment of the course. Felder et al [11] [12] has defined the many measurement to assess

the different criteria's of PO's and PEO's. But many of these measurements are rubric based measurement. Therefore, the aim of this paper is to explore varying methods of measuring CO attainment which reflect the PO achievement.

2. Co-po Mapping

Programme Outcomes for the Department of Computer Science and Engineering, SR Engineering College, Warangal are mainly adopted from NBA Manual, in this the stakeholders are students of the Department, coordinator, senior faculties and Head of the Department. The list of PO emphasizes the expectations for students of Bachelor of Technology in Computer Science and Engineering upon their graduation (TABLE 1).

Table 1. Programme Outcomes Of Department Of Computer Science And Engineering

PO No.	Program Outcome
A	An ability to apply knowledge of mathematics, science, and engineering.
B	An ability to design and conduct experiments, as well as to analyze and interpret data.
C	an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
D	An ability to function on multidisciplinary teams.
E	An ability to identify, formulates, and solves engineering problems.
F	An understanding of professional and ethical responsibility.
G	An ability to communicate effectively.
H	The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.
I	Recognition of the need for, and an ability to engage in life-long learning.
J	A knowledge of contemporary issues.
K	An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

The Faculty has predetermined the PO that needs to be mapped with the offered courses to ensure all POs are addressed. For Design and analysis of algorithms (DAA) subject 2 year 2 semesters 2011-2012, the PO that needs to be addressed is b, c, d, h, i and k. The subject coordinator has structured the course outcome (CO) with respect to appropriate assessment method as per the predetermined PO (Table 2).

Assessment for the subject includes Assignments, Mid Term Tests and Final Exam. At the end of the semester, the students are expected to get the knowledge of DAA, and their concepts are used at the time of project development. Data analysis became even more complex as each assessment is being mapped to different CO and multiple PO (Table 3 and Table 4).

Due to various understanding with regard to the CO and PO attainment, the achievement for each CO and PO are measured using two techniques, which is (1) direct measurement, and (2) segregated measurement. Direct measurement assumes that a single CO attainment reflects to the entire PO mapped to it. On the other hand, segregated measurement assumes that CO and PO to be treated as individual and segregated component.

Table 2. General Overview Of Co For Design And Analysis Of Algorithms

	Course Outcome
CO1	Able to describe the principles of Algorithms design and development.
CO2	Able to apply Algorithms principles in product design and development.
CO3	Able to demonstrate ability to develop prototype with the help of algorithms
CO4	Able to synthesis problem and solutions of algorithms in product design process.

Table 3. General Overview Of Po And Co For Design And Analysis Of Algorithms

Course Outcome	b	c	d	h	J	k
CO1		X				
CO2	X	X	X	X		X
CO3	X	X	X	X	X	
CO4	X	X			X	

Table 4. Mapping Of Assessments To Co And Po

COs	Assessments	b	c	d	h	j	k
CO1	Mid1		X				
	Mid2						
CO2	Project	X	X	X	X		X
CO3	Project	X	X	X	X	X	
CO4	Assignment 1	X	X			X	
	Assignment 2						

3. Direct Measurement

The measurements of PO are based on the mapping of CO and PO as per Table 3 with the assumption that each CO corresponds directly to respective PO. The Dean of Academic will decide the mapping of PO as per the institution's Education Objectives, which reflect to its mission and vision. Prior to discussions, head of departments will then map the pre-determined PO to departmental subjects, and finally, the subject coordinator shall construct the CO based on the predetermined PO.

Percentages of achievement are purely based on the overall marks attained by the students as shown in equation (1).

$$A = n/N \times 100\% \quad (1)$$

With A: CO or PO achievement

n: total students achieve 50% above

N: Total students

Table 5 exhibits the CO-PO achievement of Design and Analysis of Algorithms subject based on direct measurement method. It is observed that the set of data used for the assessment for respective CO will be repetitively used for other PO as well. For example, achievement for CO4 is based on Assignment 1 and 2.

Table 5. Co-po Achievement Based On Direct Measurement

COs	Assessments	B	c	d	h	J	k	Avg CO%
CO1	Mid1		59%					59%
	Mid2		53%					53%
CO2	Project	79.4%	79.4%	79.4%	79.4%		79.4%	79.4%
CO4	Assignment 1	69.3%	69.3%			69.3%		74.5%
	Assignment 2	80.2%	80.2%					
	PO%	76.3%	68%	79.4%	79.4%	69.3%	79.4%	

Table 6. Co-po Achievement Based On Segregated Measurement

COs	Assessments	B	c	d	h	J	k	Avg CO%
CO1	Test 1 Question 1 Question 2 Question 3		76.0%					76.80%
	Test 1 Question 1 Question 2 Question 3		77.6%					
CO2	Project Report Format Intro Literature Method Result Conclusion Reference	64.1%	83.3%	77.1%	63.5%	61.5%		69.9%
CO3	Idea L/ship Discussions Planning Survey	75.5%	94.8%	84.4%	96.3%		84.9%	87.2%
CO4	Assignment 1 Question 1 Question 2 Question 3	67.2%	83.9%			54.7%		79.4%
	Assignment 1 Question 1 Question 2 Question 3		90.1%					
	PO%	68.93 %	84.28%	80.75 %	79.9%	58.1%	84.9%	

The percentage of student achievement (74.5%) will result to the achievement of the entire PO mapped to CO4, which are b, c and j. Attainment for all CO and PO are observed to exceed 50% of the overall students. The outcome of this method implies that attainment of CO will reflect the attainment of PO.

4. Segregated Measurement

As the assessment of CO may be mapped to multiple PO, there is a probability that the component of a particular assessment will also be mapped to different PO. Thus, it may be more viable to measure the CO and PO achievement in segregated manner.

Taking Assignment 1 as an example, the assessment consists of four (4) questions, and the mapping of each question is as below:

- ❖ Question 1 CO 4, and PO c
- ❖ Question 2 CO 4, and PO j
- ❖ Question 3 CO 4, and PO c
- ❖ Question 4 CO 4, and PO b

Unlike previous method, the achievement to

$$A_{co} = \frac{n_{co}}{N} \times 100$$

$$A_{po} = \frac{n_{po}}{N} \times 100$$

respective CO may not necessarily translate the achievement of the entire PO mapped to it. This approach requires the subject coordinator to design their assessment, which corresponds to the structured CO, and they will also have to consider the mapping of each question to PO as well. Thus, the achievement measurement may be calculated in a segregated manner as per equation (2) and (3) below.

Where A_{co} : CO achievement
 A_{po} : PO achievement
 n_{co} : Total students achieve CO>50%
 n_{po} : Total students achieve PO>50%

Table 5 exhibits the CO-PO attainment based on segregated method. It was observed that wide range of data may be collected and problematic areas may be easily identified. However, this option involves wide series of data collection, which may result to extensive data management. Nonetheless, this option is able extract vital information with regard to students' performance and specific issues may be tackled for continuous improvement.

Attainment for all CO is observed to exceed 50%

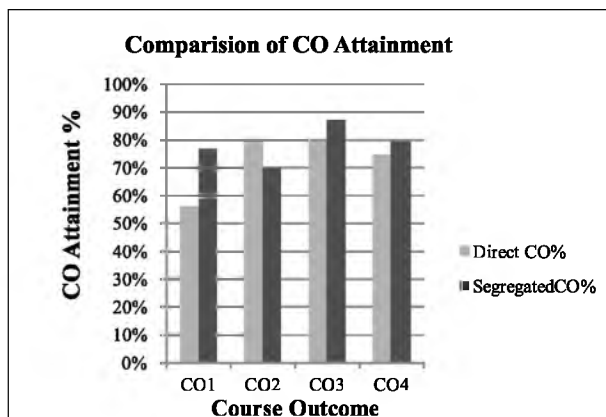


Figure1: Comparison of CO

while the attainment for PO shows that only PO j falls

below the 60% limit. Based on this finding, improvement shall be made in highlighting sustainability in design and development process. The outcome of this method implies that attainment of CO may not necessarily reflect the attainment of PO.

5. Co-po Attainment

The comparison of CO and PO attainment between the two options incorporated above is shown in Figure 1 and Figure 2. Based on Figure 1, attainment for all CO using both methods is observed to exceed 50% of the limit. Using the segregated method, it was observed that CO3 is just above the passing limit. Thus, subject coordinator may further improve the subject performance by focusing on problem synthesis and encouraging students to be more proactive towards suggesting creative solution in analysis process.

Based on Figure 2, PO attainment using direct method shows all PO achieved the 60% limit.

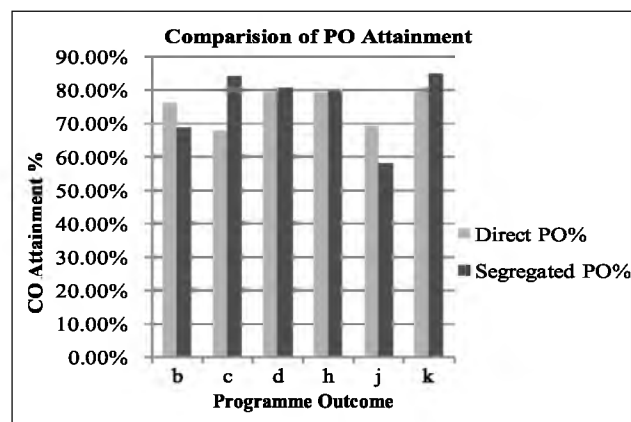


Figure 2: Comparison of PO

However, segregated method highlighted that PO k falls below the 50% limit. Referring to Table 6, the low attainment is contributed by poor interpretation to sustainability, which is measured, from Assignment's case study and Project Literature. Upon further investigation, the achievement in Literature also highlighted the issue of students' attitude towards constructing proper literature citations.

6. Conclusion

The OBE implementation of CO and PO attainment has been explored for Design and Analysis of Algorithms subject that were offered to undergraduate of Department of Computer Science and Engineering, SR Engineering College. Two methods have been incorporated which is direct method and segregated method. The direct method

implies that the CO attainment directly reflects the PO attainment. On the other hand, the segregated method implies each individual component in the assessment is mapped to its respective CO and PO and shall be assessed in segregated manner.

CO-PO attainment incorporating direct measurement and segregated measurement exhibit varying result. The segregated method is more sensitive towards identifying the issues, which affect attainment of CO and PO.

Issues related to non-fulfillment of either CO and PO can be traced to awareness towards product sustainability, problem synthesizing and student's attitude towards citing proper literature information throughout the development of their product. Continuous improvement may be implemented by focusing on the issues at hand. However, managing extensive data using segregated method may be time consuming and deters the commitment of academic members towards effective OBE implementation.

All assessments to be implemented in the course (eg. Assignment, Test, Project, Final Exam) should be prepared before the beginning of the semester. This is achievable if the subject coordinator has been involved in the same subject for at least one teaching semester since they would have adequate insight on preparing the teaching plan and the CO as per the predetermined PEO and PO.

In addition, the institution should develop a system that provides standardized CO-PO attainment analysis. The system should consider the constraints among academic members who are directly involved with data collection and data management activity. The system interface should be easily navigated as it plays a significant role towards encouraging the commitment of academic members. Data transfer activity should be developed as practical as one can be to avoid redundant process.

Finally, the effectiveness of OBE implementation goes back to the practice of the related academic members. They have to be proactive in managing the data on time so that the activity would not be too overwhelming at the end of the semester. Proper planning will definitely lead to fruitful result with less hassle in managing the extra requirement by the accreditation body.

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