ASSESSMENT OF PROGRAM OUTCOME THROUGH IMPROVED COURSE ASSESSMENT REPORT

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Abstract— The assessment of attainment of Program Educational Objectives and Program Outcomes plays an important role in the accreditation process. Program Educational objectives are usually assessed through indirect assessment tools such as alumni survey and employer survey. Program outcomes are assessed through direct and indirect assessment methods, where direct assessment includes course assessment reports, laboratory assessment reports and project assessment reports. While indirect assessment shall include exit survey, alumni survey and employer survey. The direct assessment through course assessment report is more complex and tedious process. Most of the universities have used graduate point average or percentage of passing as quantifying attribute in the process of assessment of attainment of program outcome. But the major issue is usage of graduate point average or percentage of passing doesn't give consideration to continuous internal valuation and weightage of program outcome addressed through a particular course.

In this paper we present an improved course assessment report method for assessment of attainment of program outcome by mapping the minor exam and semester end exam questions to course learning outcomes, which in turn are mapped to program outcomes. The proposed approach gives due consideration to each outcomes and hence yields better assessment.

Keywords— **Program educational objectives, program outcome, course outcome, assessment, graduate point average.**

I. INTRODUCTION

During accreditation process, each program adhering to body of knowledge defined by professional societies and process of OBE, defines the program educational objectives (PEOs) which are in line with Mission and Vision statement of the institute with due consideration to opinion of stakeholders [1]. PEOs are broad statements that describe the career and professional accomplishments that the program is preparing graduates to achieve [2]. It is a list of capabilities that a graduate student should be able to achieve during next 5 years from graduation. PEOs will compliment Quality Policy and Quality Objectives of the Institution. PEOs are written in such a way that they address the issues like educational experience, research, learning environment and service. The Table 1 presents the PEO defined for Information sconce & Engineering program in general.

Table 1: Program Educational Objectives

	Program Educational Objectives
PEO1	Graduates will have successful careers in computer engineering fields or will be able to successfully pursue advanced degrees.
PEO2	Graduates will provide solutions to challenging problems in their profession by applying computer engineering theory and principles.
PEO3	Graduates will communicate effectively, work collaboratively and exhibit high levels of professionalism and ethical responsibility
PEO4	Graduates will engage in life-long learning and professional development to adapt to rapidly changing work environment.
PEO 5	Have an ability to pursue higher studies to achieve growth in academic / research frontiers

In order to assess PEOs the Program outcomes (POs) were defined. POs are narrower statements that describe what students are expected to know and be able to do by the time of graduation [3]. The POs compliment PEOs. The POs facilitate to arrive at curriculum framework, and design of curriculum structure, content and course outcomes. Table 2 presents Program Outcomes defined for Information sconce & Engineering program at our institute

Table 2: Program Outcomes

	Program Outcomes
PO "a"	An ability to apply knowledge of mathematics, science, and engineering

PO "b"	An ability to design and conduct experiments, as well as to analyze and interpret data.
PO "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.
PO "d"	An ability to function on multidisciplinary teams.
PO "e"	An ability to identify, formulate, and solve engineering problems.
PO "f"	An understanding of professional and ethical responsibility.
PO "g"	An ability to communicate effectively
PO "h"	The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
PO "i"	A recognition of the need for, and an ability to engage in life-long learning.
PO "j"	A knowledge of contemporary issues
PO "k"	An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

For each course, the Course learning outcomes (CLOs) are written, these are the statement which clearly states what a student is expected to be able to do at the end of the module/course. The CLOs should be mapped with POs to know the degree to which the POs are achieved and in turn the PEOs can be realized. Table 3 presents CLOs defined for a course Computer Network ISC308 for the academic batch 2014-15

Table 3: Course Learning Objectives

	Course Learning Objectives-CLO
CLO1	On completion of this course, the student will be able to…
CLO2	Explain the components, processes, the behavior and significance of protocols in the design of the internet.
CLO3	Analyze the scale and limitations of current protocols, and thereby realize the need for extended version of protocols.
CLO4	Solve problems of routing, connection control and queuing mechanism for a given computer network scenario.
CLO5	Explain the structure and operation of network management.
CLO6	Develop an ability to read and interpret technical articles.

Program articulation Matrix

In order to evaluate PEOs, the program articulation matrix is defined. This articulation matrix maps Pos with PEOs. Table 4 presents the program articulation matrix. It can be seen that the POs are very closely aligned to the PEOs. Hence the attainment POs through the array of courses in ISE program should ensure the achievement of PEOs.

Table 4 Program articulation matrix

PO / PEO	a	b	c	d	E	f	g	h	i	j	k
Have a strong foundation and ability to apply the knowledge of mathematics, computer and information science, engineering, modern tools and humanities to successfully design and develop and maintain computer based systems and processes dynamically to meet customer business objectives.	✓	✓	✓		✓			✓		✓	✓
Have a broad based background to practice information science engineering in the fields of data engineering, system engineering, network engineering and software engineering.	✓	✓	✓		✓			✓		✓	✓
Have an understanding of the professional, ethical and legal responsibilities of the engineer with awareness of contemporary issues, impact of technology on society and the need for lifelong learning						✓		✓	✓		
Have an ability to participate in team oriented, open-ended activities that prepare them to work in integrated engineering environment and communicate effectively using modern tools				✓			✓			✓	✓
Have an ability to pursue higher studies to achieve growth in academic / research frontiers								✓	✓	✓	

Course articulation Matrix.

In order to assess POs each course defines course learning objectives. The mapping of CLOs with POs is course articulation matrix. Usually the level of mapping is also presented in this table where H implies high level, M is medium and L is at Low level. The Table 5 presents course articulation matrix

Table 5. Course articulation matrix

Course Learning Objectives-CLO	a	b	c	d	E	F	g	h	i	j	k
Explain the components, processes, the behavior and significance of protocols in the design of the internet.	✓										
Analyze the scale and limitations of current protocols, and thereby realize the need for extended version of protocols.	✓	✓									
Solve problems of routing, connection control and queuing mechanism for a given computer network scenario.	✓		✓								
Explain the structure and operation of network management.	✓										
Develop an ability to read and interpret technical articles.	✓						✓		✓		

2. PROPOSED METHOD

Assessment of POs by course assessment report is practiced in most of the universities [1,2,3]. Here we present an improved method for the same. The primary process which we need to carry out to follow the proposed method is; the minor exam, semester end exam and any other activities like quizzes, seminars, field work, self study etc need to be mapped to CLOs. As we have seen that CLOs are mapped with program outcomes in course articulation matrix Table 5, the assessment of PO becomes more meaningful. The Figure 1 presents the sample question paper of Minor Exam as well as SEE. The

highlighted portion depicts the CLOs being mapped to each question.

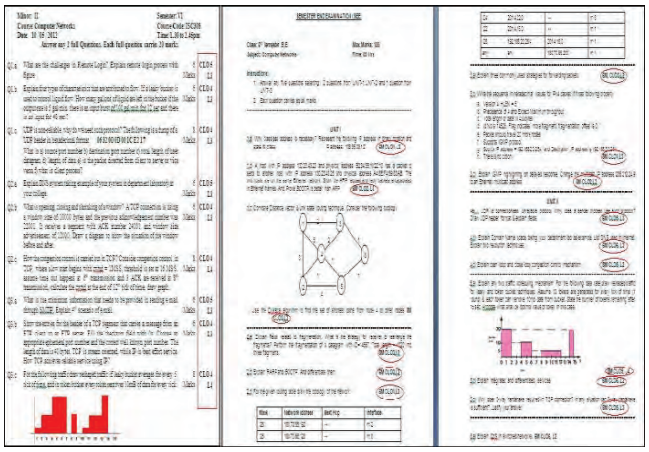

Figure 1 Sample Minor exam and Semester end exam question paper with CLO mapping

Once the Minor exam, activities as part of CIE is evaluated the allotted marks (Max Marks) and average scores of student shall be generated. Then the following attributes shall be calculated.

- Average = Total score by x number of students attempted this question out of total 'n' students / x number of students attempted this question out of total 'n' students
- Percentage = Percentage of students attempted this question
- % Attainment = (Average / Max Marks) for each question by attempted students
- Act Attainment = Actual Attainment (Considering all the students)

The following Table 7 presents the attainment of POs by CIE for course Computer Network.

Course Name : Computer Network **Department : Information Science & Engineering** **Max Marks : 50**

	Minor Exam 1									Minor Exam 2									Activity	
Question	1-A	1-B	1-C	2-A	2-B	2-C	3-A	3-B	3-C	1-A	1-B	1-C	2-A	2-B	2-C	3-A	3-B	3-C	1	2
a-k	a	a	b	a	a	b	a	a	b	a	a	c	a	a	c	a	a	c	d	g
Blooms Level	L2	L3	L3	L2	L3	L3	L2	L3	L3	L2	L2	L3	L2	L3	L3	L2	L3	L3	L3	L3
CLO	CO 1	CO 2	CO 2	CO 2	CO 2	CO 2	CO 2	CO 2	CO 2	CO 3	CO 4	CO 4	CO 4	CO 3	CO 3	CO 3	CO 3	CO 3	CO 4	CO 5
Max Marks	6.00	6.00	8.00	6.00	6.00	8.00	6.00	6.00	8.00	6.00	6.00	8.00	6.00	6.00	8.00	6.00	6.00	8.00	5.00	5.00
Average Marks	4.27	5.04	6.06	5.71	4.71	6.75	4.65	4.67	6.29	3.78	4.05	6.86	5.87	5.57	6.57	4.19	4.58	6.67	4.38	4.6
Percentage	86.67	85.56	71.11	46.67	53.33	84.44	81.11	86.67	82.22	80	86.67	82.22	68.89	82.22	82.22	57.78	54.44	50	97.78	91.11
% Attainment	71.17	84.00	75.75	95.17	78.50	84.38	77.50	77.83	78.63	63.00	67.50	85.75	97.83	92.83	82.13	69.83	76.33	83.38	87.60	92.00
Act Attainment	69.82	82.65	74.40	93.82	76.65	82.53	75.65	75.98	76.78	61.15	65.65	83.80	95.88	90.88	80.18	67.88	74.38	82.03	86.25	90.65

NOTE :

The following Table 8 presents the attainment of POs by SEE for course Computer Network.

Semester End Examination

Course Name : Computer Networks **Department : Information Science & Engineering** **Max Marks : 100**

Question	1-A	1-B	1-C	2-A	2-B	2-C	3-A	3-B	3-C	4-A	4-B	4-C	5-A	5-B	5-C	6-A	6-B	6-C	7-A	7-B	7-C	8
a-k	a	a	c	a	a	c	a	a	c	a	a	c	a	a	c	a	a	c	a	a	a	a
Blooms Level	L3	L2	L3	L2	L3	L3	L3	L2	L3	L3	L2	L3	L2	L3	L2	L2	L2	L3	L3	L2	L3	L2
CLO	CLO 3	CLO 2	CLO 2	CLO 1	CLO 2	CLO 2	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5	CLO 4	CLO 5	CLO 4	CLO 4	CLO 5	CLO 4	CLO 4	CLO 4	CLO 4	CLO 4	CLO 4
Max Marks	6.00	6.00	8.00	6.00	6.00	8.00	6.00	6.00	8.00	6.00	6.00	8.00	6.00	6.00	8.00	6.00	6.00	8.00	6.00	6.00	8.00	20.00
Average Marks	4.91	3.89	3.97	4.1	4.29	4.61	4.67	3.68	5.09	3.44	3.46	5.71	4.61	3.65	4.95	4.52	3.87	5.55	4.88	4.2	5.56	11.52
Percentage	66.67	65.28	65.97	43.75	47.92	40.97	91.67	81.25	88.89	52.08	46.53	57.64	54.86	55.56	57.64	75	74.31	81.25	76.39	77.08	70.47	21.53
% Attainment	81.77	64.88	49.61	68.25	71.5	57.63	77.78	61.4	83.67	57.33	57.71	71.39	76.79	60.83	61.9	75.31	64.49	89.34	81.36	69.97	69.47	57.58
Act Attainment	54.52	42.36	32.73	29.86	34.26	23.61	71.3	49.89	66.6	29.86	26.85	41.15	42.13	33.8	35.68	56.48	47.92	56.34	62.15	53.93	54.51	12.4

Attainment of a = 66.817 % c= 58.53%

Assessment of Attainment of PO

Once the attainment of each PO through CIE and SEE are calculated, they are entered in the following table. The red color indicates the contribution from both CIE as well as SEE (average of two scores), while blue color indicates the attainment of PO only through CIE.

Table 9 Assessment of attainment of Program outcome through Course assessment report

	Program Outcome										
Course Code	A	b	c	d	E	f	g	h	i	j	k
ISC202	59.646	73.25		45.36			54.56				67.35
ISC204	66.639	64.87		55.33							
ISC210	73.778	57.98									68.45
ISC211	66.639			87.11			48.97				
ISC215	57.28										
ISC301	64.944	71.285						59.38			62.19
ISC302	59.487	69.34	76.45	36.78			85.35				
ISC303	65.856	86.21	66.525				76.45				
ISC308	66.327	74.34	61.05	86.25			90.65				
ISC311	55.565	89.54	55.3				37.56				89.45
ISC405	61.356	75.76		77.43		59.465			75.15	64.56	
ISC408	54.652										
ISC409	65.026	87.45		68.52					69.45		87.35
ISC401	65.675	89.65					67.49				
ISC207	59.134										
ISC208	76.979		69.44								
ISC212	69.11	82.17									
ISC213	75.301						34.67				
ISC216	62.656		78.45								
ISC306	61.808	78.94									
ISC309	52.548	75.29		78.99							88.45
ISC407	67.654	69.46		63.48			86.41		89.22		79.56
Average	64.99	75.03	67.86	67.69		59.46	64.67	59.38	77.94	64.56	77.54
Attainment of PO (in the scale of 10)	6.49	7.50	6.78	6.76		5.94	6.46	5.93	7.79	6.45	7.75

From the graph we observe that all the outcomes except "e" are attained through course assessment report as this method considers both CIE and SEE. The criteria e is prominently attained through laboratory courses while f,h,I and j are prominently attained by mini and capstone project.

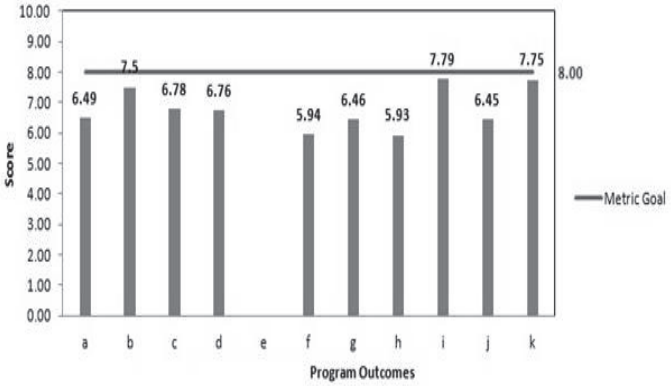

Figure 2 Assessment of attainment of PO by course assessment report using proposed method

3. CONCLUSION

In this paper we presented the process of assessment of attainment of PO through course assessment report. The drawback of existing method is it considers only semester end exam component, neglecting continuous internal valuation. GPA results are considers for assessment and is substituted in all the entries where the course is mapped to PO. The proposed method considers both CIE and SEE and it is observed that most of Pos are attained and is closer to the reality.

ACKNOWLEDGEMENT

Authors would like to thank Dr.Ashok Shettar, Principal ,BVBCET,Hubli,Karnataka , India for continuous support and encouragement.

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