

An Approach to the Evaluation of Program Outcomes

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ABSTRACT

Current global scenario demands outcome based education to develop graduates with universal acceptability. Program Outcomes (PO) laid by NBA are the assessable components indicative of graduate potential to demonstrate competencies to practice at appropriate levels. POs can be defined and calculated by assessment of various Course Outcomes (CO) which can further be evaluated from Learning Outcomes (LO). Blooms Taxonomy classifies LOs into the Cognitive, Affective and Psychomotor domains based on their level of complexity. Each LO maps to CO and hence contributes to PO. The direct and indirect assessment tools can be used to obtain course outcome attainment level. Performance at the prerequisite subject and attainment of the outcomes for previous year are the factors determining defined CO attainment. This paper describes a module for defining and calculating attainment of Program Outcomes.

Keywords: Blooms Taxonomy, Attainment, Program Outcome.

INTRODUCTION

The efficiency and effectiveness of higher and technical education should be described in terms of learning outcomes rather than number of credits or number of hours. In a teacher- centered approach the teacher decides the content to be taught, accordingly plans the content and assesses the content that has been delivered. Whereas, in a student-centered approach a student is expected to know, and be able to perform a task, at the end of a lesson. Learning Outcomes (LOs) are statements of what a learner is expected to know, understand and/or be able to demonstrate after completion of a process of learning, which are then grouped to define Course Outcomes (COs) [1]. Bloom's Taxonomy classifies LOs into three domains – Cognitive, Affective and Psychomotor. Contribution of curricular content towards the cognitive domain is good, psychomotor domain is average and poor to the affective domain.

Graduate Attributes (GA), defined by the National Board of Accreditation (NBA), are employability characteristics expected by a recruiting organization in a candidate on successful completion of the curriculum designed for a particular program. GAs are described as Program Outcomes (POs), which are specific and measurable statements that encapsulate the skills, knowledge and behaviour that students should acquire throughout the program. POs are crafted from the Program Educational Objectives (PEOs) which are to be embodied by the graduate three (3) to five (5) years after graduation and in turn are crafted from the Vision and Mission of the Institute. The level of

attainment of the GAs, or in other words the POs, can be derived from the achievement of LOs which through the COs are mapped to the POs [2].

Graduate Attributes and Program Outcomes defined by NBA for Pharmacy [3]

<i>PO No.</i>	<i>Graduate Attribute</i>	<i>Program Outcome</i>
PO1	Pharmacy Knowledge	Possess knowledge and comprehension of the core and basic knowledge associated with the profession of pharmacy, including biomedical sciences; pharmaceutical sciences; behavioral, social, and administrative pharmacy sciences; and manufacturing practices
PO2	Planning Abilities	Demonstrate effective planning abilities including time management, resource management, delegation skills and organizational skills. Develop and implement plans and organize work to meet deadlines
PO3	Problem analysis	Utilize the principles of scientific enquiry, thinking analytically, clearly and critically, while solving problems and making decisions during daily practice. Find, analyze, evaluate and apply information systematically and shall make defensible decisions
PO4	Modern tool usage	Learn, select, and apply appropriate methods and procedures, resources, and modern pharmacy-related computing tools with an understanding of the limitations
PO5	Leadership skills	Understand and consider the human reaction to change, motivation issues, leadership and team-building when planning changes required for fulfillment of practice, professional and societal responsibilities.
PO6	Professional Identity	Understand, analyze and communicate the value of their professional roles in society (e.g. health care professionals, promoters of health, educators, managers, employers, employees)
PO7	Pharmaceutical Ethics	Honour personal values and apply ethical principles in professional and social contexts. Demonstrate behavior that recognizes cultural and personal variability in values, communication and lifestyles. Use ethical frameworks; apply ethical principles while making decisions and take responsibility for the outcomes associated with the decisions
PO8	Communication	Communicate effectively with the pharmacy community and with society at large, such as, being able to comprehend and write effective reports, make effective presentations and documentation, and give and receive clear instructions
PO9	The Pharmacist and society	Apply reasoning informed by the contextual knowledge to assess societal, health, safety and legal issues and the consequent responsibilities relevant to the professional pharmacy practice
PO10	Environment and sustainability	Understand the impact of the professional pharmacy solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development
PO11	Life-long learning	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change. Self-assess and use feedback effectively from others to identify learning needs and to satisfy these needs on an ongoing basis

METHODOLOGY

For a given Program, the expected attainment of the outcomes needs to be defined quantitatively. The actual attainment is derived using several assessment tools on different units of the curriculum. This paper describes a method to assess the overall attainment of POs using defined expected attainment and calculated actual attainment. Assessment tools are directly applied to curricular content, or we can say that these tools are applied to each course of a program, making assessment of COs the primary objective. It is therefore essential to define attainment at the level of each course itself, *i.e.*, defined CO Attainment, and then calculate its contribution to a particular PO based on its mapping. The average defined attainment of all courses that mapped to a particular PO, specifies the expected level of attainment for that PO, *i.e.*, defined PO Attainment. Evaluation using the assessment tools on courses conducted will similarly provide the calculated PO Attainment.

A module in MIS (Management Information System) has been developed to capture data related to the assessment tools and their correlation to the POs. Data can be processed at several steps to identify the contribution of the various curricular activities and thereby assess the attainment of POs.

Assessment of Course Outcomes (COs)

A. Defined CO Attainment

Generally, performance levels of students at the end of an academic year are measured in comparison to the performance at the same level by other batches of students in the previous academic years. However, most often what is not taken into consideration is the performance at the level prior to that being assessed. It is therefore essential to capture these values to create a comparable parameter for assessing performance levels over different batches of students. Since the curriculum conducted for the batches of students is the same, the Defined CO Attainment is calculated for each course in each academic year as the average of the

- Result of pre-requisite course for the students being assessed
- Result of the course being assessed in the previous academic year

<i>Course being Assessed</i>	<i>Anatomy Physiology Pathophysiology I (Course 01)</i>	<i>Anatomy Physiology Pathophysiology II</i>
Result in previous academic year	75.52 %	80.26 %
Pre-requisite subject	Biology at Std. XII	Anatomy Physiology Pathophysiology I
Result of pre-requisite subject	85.56 %	75.52 %
Defined CO Attainment	80.54 %	77.89 %

B. Calculated CO Attainment

Learning Outcomes (LOs) for every course were classified, based on their level of complexity, into the six levels of the cognitive domain as defined by Bloom's Taxonomy. Each level was assigned an expected attainment value. The % attainment value is the expected percentage of marks that a

student should secure on attempting questions related to the particular level of Bloom's Taxonomy. The defined attainment decreases with the increasing complexity of the learning outcome. Assessment of the attainment of LOs is done by mapping the questions asked in a written exam (the formal evaluation method for any program) to the level of Bloom's Taxonomy as follows:

<i>Level</i>	<i>Description</i>	<i>Expected Attainment (EA)</i>	<i>Assessment</i>
Knowledge	Recalling or remembering	70%	Example for a Knowledge based question No. of students securing \geq EA of the maximum marks for that question X 100 No. of students attempting that question
Comprehension	Understanding something that has been communicated	60%	
Application	Using a general concept to solve problems in a particular situation;	50%	
Analysis	Focus on identification of parts or analysis of relationships between parts,	40%	
Synthesis	Creating something new by putting parts of different ideas together	30%	
Evaluation	judging with the use of definite criteria	20%	

(Since 70% is awarded as First Class with Distinction, we chose this as the highest level. Followed by 10% intervals for others).

The quantitative assessment for each LO is mapped to the respective CO. The average of all contributions from the various assessment tools is taken as the Calculated CO Attainment.

<i>Course 01</i>	<i>Direct Assessment</i>						<i>In Direct Assessment</i>		<i>Calculated CO Attainment</i>	
	<i>A</i>	<i>Quiz</i>					<i>PT</i>	<i>ESE</i>		<i>Course Exit Form</i>
	<i>1</i>	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>				
CO 1	92	89					85.53	69.93	66.35	80.56
CO 2	89		75			76.60	76.63	69.93	54.25	74.29
CO 3				93.33			72.32	69.93	45.52	70.27
CO 4					89.66			69.93	70.12	76.57

(A-Assignment, PT-Internal Test, ESE-End Semester Exam)

Evaluating Program Outcomes

Each CO maps to POs with strong (100% Define and Calculated PO Value), medium (80% of Define and Calculated PO Value) or weak (60% of Define and Calculated PO Value) contributions. Parallel calculations were done for evaluating the contribution of COs, Courses and Semesters sequentially using the 'Defined CO Attainment' value and the 'Calculated CO Attainment' value.

Following calculations are done for defined CO and calculated CO for each Course Outcome of a course and mapped to the respective PO.

Defined PO Attainment for each CO

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	80.54					64.43				48.32	64.43
CO2	80.54					64.43				48.32	64.43
CO3	80.54			48.32		64.43				48.32	64.43
CO4	80.54			64.43		64.43				48.32	64.43
Course 1	80.54			56.37		64.43				48.32	64.43

Calculated PO Attainment for each CO

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	80.56					64.44				48.33	64.44
CO2	74.29					59.43				44.57	59.43
CO3	70.27			42.16		56.21				42.16	56.21
CO4	76.57			61.25		61.25				45.94	61.25
Course 1	75.42			51.70		60.33				45.25	60.33

The last row provides the average attainment of each PO for this Course. Similar calculations were done for all courses of the semester and the average attainments were tabulated as below

Defined PO Attainment

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
Course 1	80.54			56.37		64.43				48.32	64.43
Course 2	78.89	45.23	53.54		58.75		71.23		65.62	63.21	
Course 3	79.80			60.67	73.72	56.54	68.83	54.21		54.25	56.34
Course 4	83.24		58.89	63.78	45.65		54.57		75.53	72.42	
Semester 1	80.61	45.23	56.21	60.27	59.37	60.48	64.87	54.21	70.57	59.55	60.38

Calculated PO Attainment

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
Course 1	75.42			51.7		60.33				45.25	60.33
Course 2	73.73	41.20	52.14		51.723		74.2		61.62	62.22	
Course 3	78.19			57.63	74.72	52.84	64.23	52.21		54.33	57.13
Course 4	80.19		54.83	61.74	43.56		55.54		71.53	71.12	
Semester 1	76.88	41.20	53.49	57.02	56.67	56.59	64.66	52.21	66.58	58.23	58.73

The last row provides the average attainment of each PO for this Semester. Similar calculations were done for all the semesters and the average attainments were tabulated as below.

Defined PO Attainment

	<i>PO1</i>	<i>PO2</i>	<i>PO3</i>	<i>PO4</i>	<i>PO5</i>	<i>PO6</i>	<i>PO7</i>	<i>PO8</i>	<i>PO9</i>	<i>PO10</i>	<i>PO11</i>
Semester 1	80.61	45.23	56.21	60.27	59.37	60.48	64.87	54.21	70.57	59.55	60.38
Semester 2	84.58	47.56	51.45	79.94	55.24	65.45	62.32	66.23	69.23	65.62	45.25
Semester 3	83.23	53.24	59.64	78.18	50.12	62.23	64.56	56.25	82.45	56.14	70.54
Semester 4	79.94	60.28	56.25	82.45	56.14	70.12	68.87	52.23	65.54	87.27	69.89
Semester 5	78.18	55.64	75.87	59.54	58	79.48	79.94	51.19	72.23	48.89	75.87
Semester 6	82.45	49.54	70.14	55.64	51.24	75.24	78.18	60.16	59.54	58	70.14
Semester 7	89.45	62.61	78.48	66.67	49.25	71.65	82.45	62.45	55.64	51.24	74.23
Semester 8	90.19	50.50	70.12	63.62	52.63	69.23	84.24	65.62	80.18	85.25	82.14
Program	83.58	53.08	64.77	68.29	54.00	69.24	73.18	58.54	69.42	64.00	68.56

Calculated PO Attainment

	<i>PO1</i>	<i>PO2</i>	<i>PO3</i>	<i>PO4</i>	<i>PO5</i>	<i>PO6</i>	<i>PO7</i>	<i>PO8</i>	<i>PO9</i>	<i>PO10</i>	<i>PO11</i>
Semester 1	76.88	40.25	51.23	56.23	54.12	51.23	61.23	52.89	65.23	54.23	56.31
Semester 2	82.35	45.54	50.21	76.25	56.23	63.23	60.23	65.23	68.75	64.23	46.23
Semester 3	79.54	51.26	55.62	75.32	49.23	60.24	61.78	55.96	81.85	54.28	69.78
Semester 4	80.25	58.23	55.13	80.25	54.14	68.21	64.59	50.89	64.23	85.67	65.23
Semester 5	74.13	52.21	74.21	57.23	55.32	76.23	79.85	50.47	70.23	46.17	74.23
Semester 6	80.26	47.26	69.25	54.15	49.13	72.13	75.23	59.55	54.23	56.32	67.25
Semester 7	85.53	60.21	76.23	65.89	47.23	70.58	80.24	61.25	52.23	50.78	70.98
Semester 8	88.25	48.15	69.25	61.78	50.27	70.96	82.35	64.98	80.09	83.23	80.37
Program	80.90	50.39	62.64	65.89	51.96	66.60	70.69	57.65	67.11	61.86	66.30

Assessing the Attainment of Program Outcomes

Calculated PO Attainments and Defined PO Attainments are derived from Calculated CO Attainment and Defined CO Attainment respectively. Ratio of the Calculated PO Attainment to the Defined PO Attainment will give us an assessment of PO Attainment.

	<i>PO1</i>	<i>PO2</i>	<i>PO3</i>	<i>PO4</i>	<i>PO5</i>	<i>PO6</i>	<i>PO7</i>	<i>PO8</i>	<i>PO9</i>	<i>PO10</i>	<i>PO11</i>
Calculated	80.90	50.39	62.64	65.89	51.96	66.60	70.69	57.65	67.11	61.86	66.30
Defined	83.58	53.08	64.77	68.29	54.00	69.24	73.18	58.54	69.42	64.00	68.56
Assessment	96.76	94.93	96.71	96.49	96.22	96.19	96.60	98.48	96.67	96.66	96.70

CONCLUSION

PO Attainment indicates the level of achievement of GAs in graduates. Assessments of PO Attainment can be done at every stage from Course Outcomes at each semester till completion of program. The advantage is identification of weak contributions so that corrective actions can be taken at appropriate stages. POs that have weak contributions can be identified and their attainment can be supplemented with additional 'Beyond Syllabus Activities' to develop graduates with the desired attributes. This module is iterative and helps faculty design the curriculum so as to define higher PO Attainment values and plan activities to achieve them.

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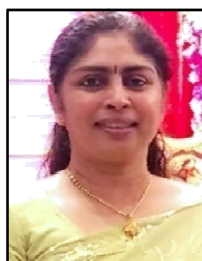
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