

Achieving Academic Excellence through Outcome based education - A case study

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Abstract

Background : Attaining acceptable delivery performance is the most significant academic challenge faced by many universities and particularly private run institutions.

Aim: This project implementation is carried out using the outcome based education model. To gain an edge over competitors in an increasingly global and competitive marketplace, institutions today need to differentiate themselves not only in cost, but in the overall value of the educational programmes they offer. As customers demand more and more variety of skill driven programmes to cater to wider markets, the issue of mobility and portability becomes increasingly challenging.

Results: In reviewing the characteristics of outcomes-based education, there appears to be a shift towards learning rather than teaching, to providing experience rather than information. There is a move from normative, paper-based examinations towards outcomes-based assessment as reflected in national standards

Conclusion: This change is not only intended to meet the needs of industry more effectively, but also to create 'empowered' individuals who can take control of their own learning and their lives. As such, outcomes-based education has presented an opportunity to widen opportunities for learning and to promote equality. Using the bloom's taxonomy the outcome based education is implemented in an engineering undergraduate programme.

Keywords : Educational Objectives, Programme specific criteria, and Course curriculum

Introduction

The National Board of Accreditation (NBA) has laid out guidelines for academic organizations to pursue excellence in order to get accreditation. Those guidelines are followed to define the programme outcomes and the course outcomes. This paper indicates the quantification of the programme outcome. Course outcomes are statements of what a learner is expected to know, understand and/or be able to demonstrate at the end of a period of learning. They are explicit statements about the outcomes of learning – the results of learning. They are usually defined in terms of a mixture of knowledge, skills, abilities, attitudes and understanding that an individual will attain as a result of his or her successful engagement in a particular set of higher education experiences^{1,2}. In reality, they represent much more than this. They exemplify a particular methodological approach for the expression and description of the curriculum.

Program Outcome(PO) :

Ability to:

- Apply knowledge of mathematics, science and engineering
- Design and conduct experiments, as well as analyze and interpret data.
- Design and improve integrated systems of people, materials, information, facilities, and technology.
- Function as a member of a multi-disciplinary team.
- Identify, formulate and solve industrial and systems engineering problems.
- Understand and respect professional and ethical responsibility.
- Communicate effectively both orally and in writing.
- Understand the impact of engineering solutions in a global and societal context.

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- i. Recognize the need for and an ability to engage in life-long learning. Industrial and system engineering throughout their professional careers.
- j. Have knowledge of contemporary issues. l. Manage Projects and Finance.
- k. Use update techniques, skills and tools of

The following table gives information about the courses offered for the programme and the outcome associated with each course. Example,

Table 1 : Courses and their Outcomes

Course Code	Course Name	Course Outcomes
MAT101	Engineering Mathematics –I	<ul style="list-style-type: none"> · Understand polar curves and use this concept to find different parameters. · Using the concept of partial differentiation find the derivatives of implicit and composite functions, check the functional dependency using Jacobians, solve differential equations and extreme values of functions.
PHY 101/201	Engineering Physics	<ul style="list-style-type: none"> · Analyse and determine M.I. and elastic behaviour of materials. · Analyse and determine the wavelength of the laser. · Analyse and calculate the numerical aperture, number of modes and the attenuation in the optical fiber.
PHYL101/201	Engineering Physics Laboratory /Tutorial	<ul style="list-style-type: none"> · Analyse and determine M.I. and elastic behaviour of materials. · Analyse and determine the wavelength of the laser, radius of curvature of a lens

A Note on where the POs are Published and Disseminated^{3,4}

- The POs are published at
- Department website :
 - College website
 - Curricula books
 - Rules and Regulation books
 - ISO quality manual (e-copy)
 - Department notice boards

Apart from this, they are disseminated to all the stakeholders of the programs through

- Orientation programme conducted during the induction of a new academic batch.
- Awareness workshops to students and faculty periodically

Processes Employed for Defining of the POs

The Programme outcomes are defined taking into account the feedback received from faculty, alumni, Industry. Also the guidelines from the regulatory, professional bodies and graduate attributes in line with programme educational objectives which are in line with the mission and vision statement of the institute and the department⁵.

The following figure indicates the information flow.

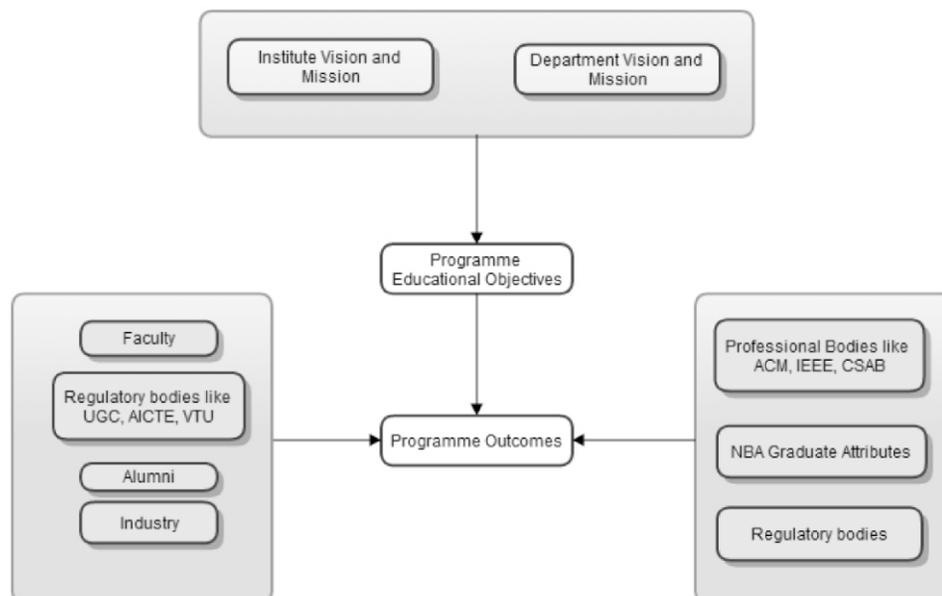


Fig 1: Process Employed for Defining of the POs

Alignment of the Defined POs to the Graduate Attributes Prescribed by the NBA**Table 2: Mapping of NBA's Graduate Attributes to Programme Outcomes (template)**

The relationship between Graduate Attribute's with the PO's is mapped & the same is represented in table 2 :

Sl. No.	Graduate Attributes	Programme Outcomes											
		a	b	c	d	e	f	g	h	i	j	k	l
1	Engineering knowledge	X	X			X							
2	Problem analysis	X	X			X							
3	Design/development of solutions			X		X							
4	Conduct investigations of complex problems					X							X
5	Modern tool usage							X				X	
6	The engineer and the society				X		X	X					
7	Environment and sustainability							X	X			X	X
8	Ethics						X	X					
9	Individual and team work				X								
10	Communication				X			X					
11	Project management and finance									X		X	X
12	Life-long learning								X		X		X

Table 3: Correlation between the POs and the PEOs

The Program Educational objectives and Programme outcomes are mapped in the table shown below:

Sl. No.	Programme Educational Objectives	Programme Outcomes											
		a	b	c	d	e	f	g	h	i	j	k	l
1	Apply the engineering practices to model and analyze the real life problems and interpret the results.		X			X		X					
2	Effectively design, implement, improve and manage the integrated socio-technical systems.	X		X								X	
3	Build and lead cross-functional teams, upholding the professional responsibilities & ethical values.				X		X						X
4	Engage in continuing education and life-long learning to be competitive and enterprising.								X	X	X		

Example:**An understanding of project and finance management.**

The graduate is expected to become a team leader or project manager in three to five years after graduation. In this role he/she will be required to manage project teams, chart the activities, set goals and deadlines, allocate machine or human resources, monitor the progress and complete the project. All the while, he/she might need to make informed decisions keeping in mind the budget and business requirements specified by the client. Programme outcome (l) supports programme educational objective (3).

Attainment of programme outcomes:

The following table gives the list of courses of the programme along with the mapping against PO's keeping in mind the outcome for each course. The table reflects the contribution of individual courses in attainment of PO's.

Contribution of the Course Outcomes to the POs

Courses are mapped with PO's which are represented in the table represented Table 4 :

Table 4: Mapping of Course Outcomes contributing to PO Attainment

Sl. No.	Code	Course	Programme Outcomes											
			a	b	c	d	e	f	g	h	i	j	k	l
1.	MAT101	Engineering Mathematics – I	X				X			X				
2.	PHY101	Engineering Physics	X	X		X								
3.	PHYL101/201	Engineering Physics Lab	X	X		X								
4.	CV101/201	Basic Civil Engineering & Mechanics	X		X									X

Modes of Delivery of Courses in the Attainment of the POs

Different modes of course delivery are identified and represented in Table 5.

Table 5: Modes of Course Delivery

Sl. No.	Mode of Delivery	Programme Outcomes											
		a	b	c	d	e	f	g	h	i	j	k	l
1.	Lectures using chalkboard or presentations interspersed with discussions	X	X	X					X			X	X
2.	Tutorials	X		X		X						X	
3.	Demonstrations in laboratory		X					X			X	X	
4.	Practical exercises	X	X	X		X							
5.	Projects			X	X	X						X	X
6.	Industrial Training				X			X			X		
7.	Seminars							X		X	X		

Contribution of Assessment Tools that are used to Assess the Impact of Delivery of Course towards the Attainment of Course Outcomes/Programme Outcomes

The following methods of assessment are identified for assessing the impact of course delivery and course content².

1. Direct method

- Continuous Internal Evaluation (CIE) tests⁷
- Semester End examinations
- Practical tests
- Project
- Seminar Presentations

2. Indirect method

- Employer Survey(Industry Survey)
- Alumni Survey
- Parents Survey
- Student feedback survey

Attainment of Programme Outcomes

Since each course is defined to address specific program outcomes, the **Direct methods** and the

Indirect methods of course assessment are used to map attainment of course outcomes to assess whether program outcomes are attained¹⁰⁻¹².

The Direct methods of course assessment used are:

- CIE
- SEE

The Indirect methods of course assessment used are:

- Employer Survey(Industry Survey)
- Alumni Survey
- Parent Survey
- Student Survey

Extent to which the Laboratory and Project Course Work are contributing towards the Attainment of each PO

As a student progresses through the undergraduate programme, balance can be witnessed for a few courses where student is required to possess both theory as well as practical (laboratory) application knowledge and also Project exposure.

Table below gives details of the laboratory courses offered : Example

Table 6: Laboratory work contributing towards attainment of PO's

Sl. No.	Course Code	Lab Title	PO's											
			a	b	c	d	e	f	g	h	i	j	k	l
1	307	Process Lab	X	X	X	X								
2	308	Material Lab	X	X			X		X					
3	309	Design Lab	X	X	X		X							
4	407	Metrology Lab	X	X			X							

The following table maps the Project outcomes with the PO'. They are derived from individual projects carried out which is represented in table 7. Example

Table 7: Mapping of project outcomes with programme outcomes

Sl. Project Outcomes No.	PO											
	a	b	c	d	e	f	g	h	i	j	k	l
Implementation of Information Technology to improve productivity springs design			X	X								X
The process improvement was achieved by redesigning the flow of material at supplier and at the plant level			X		X					X	X	
The minimization of changeover time in the capacitor assembly line has led to productivity improvement.			X					X			X	

Assessment Tools and Processes used for Assessing the Attainment of each PO

Assessment Process

Course outcomes of each course must be mapped with programme outcomes. The sample of course articulation matrix is provided below:

Table 8: Sample for Course Articulation Matrix for Business Management

Sl. No.	Course Outcomes	Programme Outcomes											
		a	b	c	d	e	f	g	h	i	j	k	l
1.	A understanding of business enterprises			X		X					X		
2.	To apply business systems, procedures and processes			X	X						X		
3.	To evaluate managerial roles and responsibilities			X		X						X	

Information on Data Collection Process

The following types of information are collected : Question papers of CIE tests, Question papers of Semester end exam, Question papers of practical tests/ quizzes, Course exit survey, Student exit survey, Employer survey, Placement records, Alumni Survey. The Data Collection was done once in 6 months.

Results of Evaluation of Each PO considering all the courses offered by the programme.

Below table is used to tabulate the results of direct and indirect assessments and hence to assess the attainment of program outcomes. The attainment level of a PO using direct methods is the average of the attainment levels of each course that address that PO. The attainment level of a PO using indirect methods is the average of the attainment levels of all related assessment tools. Finally the attainment level of a PO is the average of its attainment levels using direct and indirect measurements.

PO : a : Ability to apply knowledge of Mathematics, Science and Engineering :

Sl No	POs	Courses pertaining to PO	Measurement of Attainment by direct assessment method	Measurement of Attainment by indirect assessment method	Expected level of attainment
1		Courses are mentioned below in table	Avg marks of Continuous Internal Evaluation (CIE) tests, Semester End examinations, Practical tests, Project & Seminar Presentations.	By Industry, Alumni, Parents & Students	By experience and earlier records
2	PO: a		46.41	40.00	65

The courses of the program listed in table below are used to assess the attainment level of **PO^{3,4}: a**

Sl. No	Course Code	Course Name	Average Attainment Level	
			2007-2011	2008-2012
1	MAT 101	Engineering Mathematics-I	48.75	41.53
2	PHY 101/201	Engineering Physics	33.54	30.93
3	PHYL101/201	Engineering Physics Lab	56.04	-
4	CV 101/201	Basic Civil Engineering & Mechanics	43.13	40.89
5	EE 101/201	Basic Electrical Engineering	41.04	38.98
6	CS 101/201	Fundamentals of Computing	48.33	28.6
8	ME 102/202	Computer Aided Engineering Drawing	66.46	54.24
9	MAT 201	Engineering Mathematics-II	41.67	48.09
10	CHY 101/201	Engineering Chemistry	50.21	41.74
11	CHYL 101/201	Engineering Chemistry Lab	82.5	-
12	ME 101/201	Elements of Mechanical Engineering	50.42	42.37
13	EC 101/201	Basic Electronics	43.33	27.75
Average attainment level- Direct method			47.96	44.24
1. Industry			-	41.50
2. Alumni			-	41.30
3. Parents			-	41.70
4. Students			-	35.50
Average attainment level- Indirect method			-	40.00

Example: Illustration of the calculation for the average attainment level is shown in table below for course MAT-101(Engineering Mathematics-I):

Grade	S	A	B	C	D	E	F
Weightage	0.4	0.25	0.15	0.1	0.05	0.05	0

$$\text{Actual attainment (\%)} = (0.4 S + 0.25 A + 0.15 B + 0.1C + 0.05D + 0.05E) / (0.4 X N)$$

S = No. of student obtained S grade

A = No. of student obtained A grade

B = No. of student obtained B grade,

C = No. of student obtained C grade

D = No. of student obtained D grade

E = No. of student obtained E grade

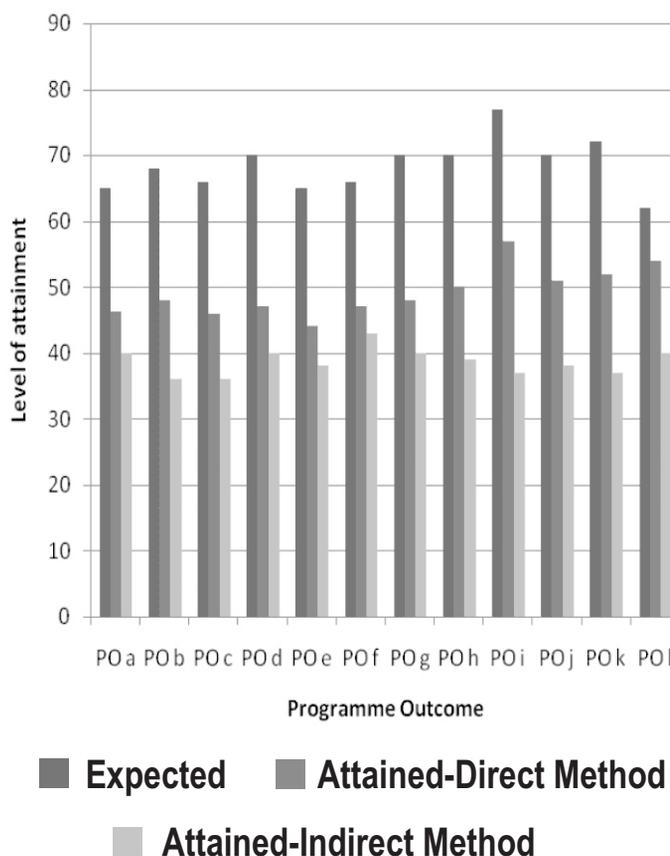
N = Total no. of student

Sample calculation for Engineering mathematics-I (MAT101)

$$\text{Actual attainment (\%)} =$$

$$(0.4 X 5 + 0.25 X 18 + 0.15 X 16 + 0.1 X 3 + 0.05 X 7 + 0.05 X 5) / (0.4 X 59) = 41.53\%$$

The chart indicates the actual level of attainment and the expected level of attainment of individual PO's:



Use of Evaluation Results towards the Improvement of the Programme

The reality check of the POs being achieved or not will be carried out only after successful completion of OBE based programme, however the action plan for carrying out the reality check is as follows.

- The measurement of the outcome.
- If deviations are noticed / observed, remedial measures will be taken.
- The course coordinators will interact with the programme coordinator.
- The reasons for deviation or gap will be analyzed.
- The factors to achieve the desired POs will be listed.
- The matter will be discussed at length during Board of Studies (BOS) and the appropriate syllabus and scheme will be approved.
- All the stake holders will be taken into confidence if the POs are to be redesigned.

Results of assessment used for improvement of course delivery and assessment

- At the end of the semester, student feedback (graduate surveys, employer survey, alumni survey and professional body survey) will be taken.
- The feedback will be discussed at length involving all faculties and HOD in the department meetings on the issue of the pace of delivery , the use of teaching aids, punctuality, role playing, posing questions to students, giving equal opportunity to students in posing questions, clarifying doubts, demonstrating case studies etc.
- Continuous training will be imparted to all faculty members.

The process used for revising/redefining the POs

Considering the graduate attributes the PO will be assessed for its attainment. The following processes are used for redefining the POs.

Advantages of OBE

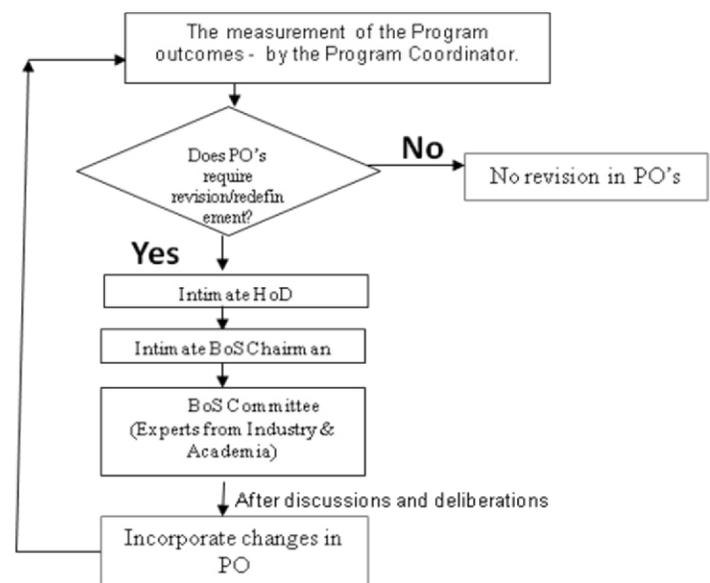
OBE has several advantages for the education and training in South Africa, such as the following:

- Learners know exactly what is expected from them as unit standards make it very clear what is required from them. There is greater buy-in and support for OBE from all role-players due to the extensive level of consultation and stakeholder involvement.
- OBE requires that international best practices be incorporated in training design.

- Well-defined assessment criteria makes it clear to both assessors & learners how assessment will take place.
- Assessment is more objective and fair as a result of the predetermined assessment criteria.
- OBE promotes the acquisition of specific skills and competencies in a country in which there are many skills shortages.
- OBE fosters a better integration between education at school, workplace and higher education level.
- OBE helps learners to accept responsibility for learning, as they are now at the centre of the learning process.
- Recognition of prior learning prevents the duplication and repetition of previous learning situations.

Disadvantages of OBE

- Most learners are not ready to adapt to OBE because the gap between a trainer-led system and a learner-centred approach does not happen overnight.
- OBE requires that all learning material be rewritten which requires a major investment in time & resources.
- The process of generating and registering of unit standards is very slow.
- Indian academic structures are bureaucratic and by their very nature inhibit the good intentions of an OBE approach.
- People with vested interests and strong personalities in standard-generating bodies may manipulate the standard setting process to achieve their own objectives.
- The rapid changes in the modern work environment often require short-term follow-up training, a situation in which training staff can not wait for unit standards to be generated or updated.



Conclusion:

The Institute has potential scope to improve “Every Academic Process”. The vision of the institute and departmental mission has to be in alignment. The industry input is critical in designing the curricula to cater to the emerging markets. The continuous training of the faculty along with the state of the art laboratory is very much required to attain the vision. Faculty exchange programmes goes a long way in transforming the attitude and the perspective of the faculty members. Standard metrics must be in place to measure all academic processes and take corrective action. This study on quantification of the programme outcomes is one alternative method where research could be done.

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