

# Study of Implementing Learning based Outcome Education in Electronics and Communication Engineering in Indian Universities.

<sup>1</sup>Dr.E.N.Ganesh

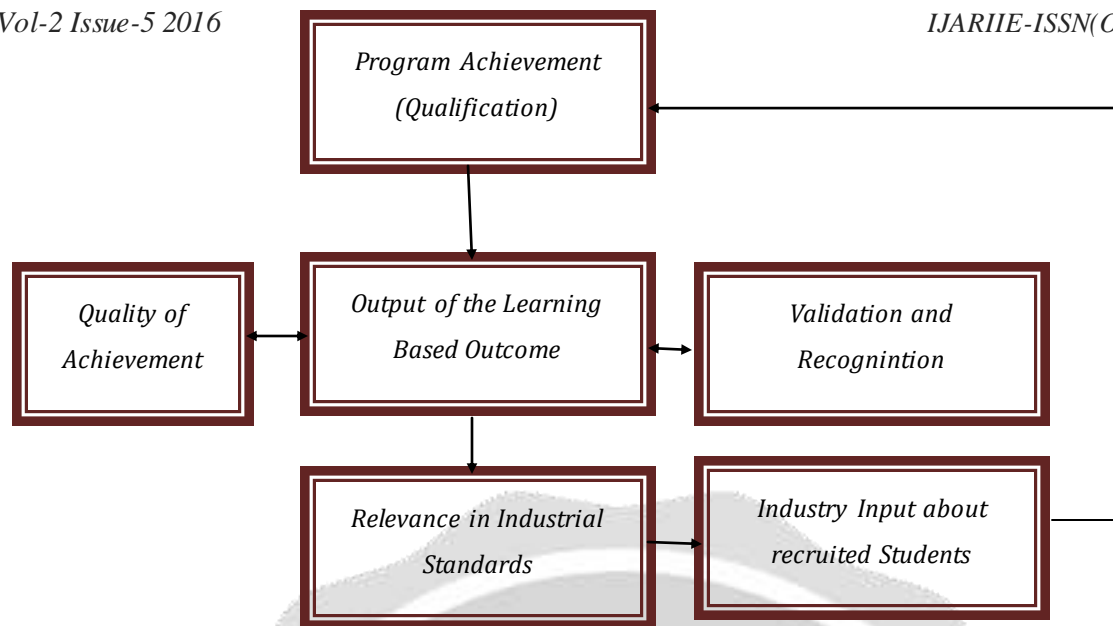
1. Professor - Saveetha Engineering College, Chennai

## Abstract

*In Indian University Professional education written in terms of syllabi describing what to be taught in the class room. Unfortunately, what has been taught and what students actually learn are often quite different, and successful students should be expected to know or be able to do that is the learning outcomes for professional courses. The aim of this paper is to provide information to university teachers about an outcomes-based approach to adapt to the present Industrial requirements. In outcome based education, students are responsible for their own learning and the assessment of learning are based on the outcomes instead of the contents. In this paper, the issues and challenges of implementing a learning based education in engineering education is discussed particularly in Electronics and Communication discipline in Indian universities. Also this paper discusses outcome related to employability and effective curriculum design for engineering students in Indian universities in Electronics and Communication stream. A case study of a subject in Electronics stream is taken and how that can be effectively evaluated is discussed in detail.*

## 1.0 Introduction:

The outcome based approach of engineering education has been mandated as compulsory for accreditation of an engineering programme to get the quality engineering professionals. The OBE itself is a recurring education reform model which is based on a student centered learning philosophy and focuses on the output (outcomes) instead of the input [1] [2]. Learning outcomes provide verifiable statements of what learners who have obtained a particular qualification, or completed a programme or its components, are expected to know, understand and/or be able to do. Learning outcome statements are typically characterized by the use of active verbs expressing knowledge, comprehension, application, analysis, synthesis and evaluation. This definition serves to emphasize the links that must exist between teaching, learning and assessment. Learning outcomes that are not assessed are merely aspirations. Learning outcomes can be written for an entire learning programme, a course, a unit or even for a single lesson. The learning outcomes approach focuses on what the learner has achieved and is able to demonstrate at the end of the learning activity rather than on the intentions of the teacher. This student-centered approach is what makes the difference between the aim, the objective and the learning outcome of a teaching activity. Aims and objectives are therefore expressed from the teacher's point of view and deal with the intended results of teaching and learning. Learning outcomes, however, consider learning from the students' point of view and deal with the achieved results. A learning outcome is a specific statement that indicates what a student should know and be able to do as a result of the learning[7][12]. Such learning outcomes are specific, verifiable, student-centered and performance-based.



**Figure 1: Learning Outcomes in Professional Education.**

## 2.0 Learning outcomes and Employability

In any learning outcomes-based approach the curriculum must be concerned with both content to be learned and attitude, ability to be developed. Therefore the proposed approach must account for both aspects. This will involve far more than merely writing a wish list of desirable outcomes [10][11]. The starting point must be a clear statement of the learning outcomes required following any period of study only once this has been done should consideration be given to the delivery of the learning programme in terms of the teaching, learning and assessment strategies. In conclusion, when writing learning outcomes for a course or module, the writer should take into account the transferable skills which are being developed on achievement of the learning outcome, thus aiding the employability of the students. The role of learning outcomes is illustrated in Figure 1. The graduate program of the student should be related with the learning outcome from which the quality and recognition of the students can be obtained and also feedback from the students can shape the quality of outcome based education as shown in figure 1. In the next section, outcome based design of curriculum in the universities are discussed.

## 3.0 Outcome based Curriculum design Process

The context of learning outcomes-based approach is presented in this section. Suppose in a Engineering subject ,at the end of the course the student should be able to **define** the terms Example : *wavelength, frequency, amplitude* and *node*, **recall** the relative frequencies or wavelengths of the various regions in the electromagnetic spectrum, **describe** the wavelength spectrum and **use** it to account for the applications in say Microwave and satellites etc, **discuss** the limitation of the fields , **use many technical examples** and finally **name** and **state** the relationships between the what been learnt and existent technology [8]. In the first instance ability to identify the problems and find the solutions with thorough analyzation and also select apply relevant methods to realize and develop the strategies and designs to meet specific requirements are essential. Finally the formulation of the problem solving and demonstration of the results with innovative ideas will give in depth learning for our students [2][9]

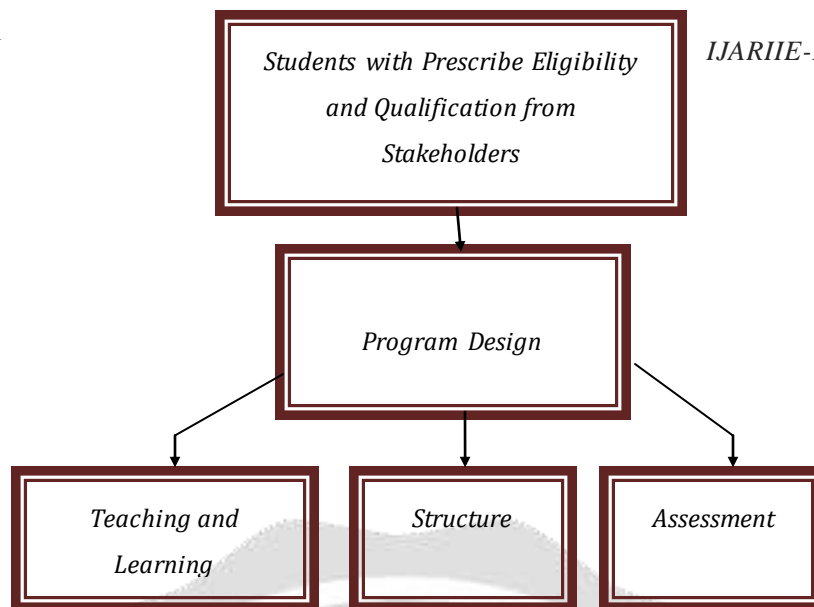


Figure 2: Outcome based Curriculum design Process

Institutions will need to ensure that the learning programmes that they deliver provide the following

1. Combination of Knowledge and discipline with appropriate integration of skills and values.
2. Opportunities for the demonstration and assessment of required competencies.
3. To ensure effective preparation for the world of professional practice, and lifelong learning.

The processes associated with the development and delivery of an outcomes-based qualification will be presented as a three-stage process:

Stage 1: Description of the expected competencies of graduates from the Professional Programme.

Stage 2: Establishing the content and learning activities required to support the achievement of the outcomes required.

Stage 3: Programme Delivery: - Providing the teaching, learning and assessment strategies that will facilitate the development and assessment of the outcomes associated with the qualification.

#### 4.0 Outcome based Educational Approach

The Professional Graduates from engineering programmes are expected to acquire a set of skills, knowledge and behaviors which is defined by Accreditation Board for Engineering and Technology (ABET) as Engineering Criteria 2000 (EC2000). The implementation of outcome based education (OBE) is essential for the Quality of engineering education which led to becoming the focal point for educational reforms. In outcome based education, students are responsible for their own learning and the assessment of learning should be based on the outcomes instead of the contents being taught. In this paper, we discussed the issues and challenges of implementing an outcome based education in engineering education particularly in ECE Stream in Indian Universities. The following 13 Program outcomes are given for ECE subjects that can be taken to evaluate PO and LO.

1. Knowledge in engineering fundamentals and ability to find the solution of complex engineering problems;
2. Analyze complex engineering problems with Precise conclusions.
3. Ability to design solutions for complex engineering problems and design systems and components.

4. Ability to conduct investigation into complex problems and conduct experiments.
5. Ability to create and apply appropriate techniques with the use of modern engineering IT tools.
6. Ability to apply reasoning to assess societal, health, safety, legal and cultural issues.
7. Ability to understand the impact of professional engineering solutions in societal and environmental Contexts.
8. Ability to apply ethical principles.
9. Ability to communicate effectively on complex engineering activities with the engineering community and design documentation and make effective presentations.
10. Ability to function effectively as an individual, and as a member or leader in diverse teams.
11. Ability to recognize the need for lifelong learning in the broadest context of technological change;
12. Ability to demonstrate knowledge and understanding of engineering and management principles.
13. Ability to apply the above to one's own work to understand and manage projects and in multidisciplinary environments.

The achievement of the thirteen Programme Outcomes must be attained by the graduates upon completion of the engineering programmes as an indicator for the implementation of outcome based approach [3] [4]. These PO should also be directed mapped to Programme Educational Objectives (PEO) which are attributes expected to be acquired by the graduates after graduation of the course [3]. Various inputs from internal and external stakeholders such as local government, industries, alumni, employers, advisory panels, students and parents are taken into consideration in developing the PEO for the programme. The implementation of outcome based education is the difficult process While it emphasizes the achievement of outcomes, this also refers to the achievement of learning outcomes (LO) for a particular course. The main aim for an academic programme is to further map the courses LO to the PO in order to observe the accumulative sum of LO contributing to the achievement of PO.

<b>Courses / Program Outcomes</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>	<b>11</b>	<b>12</b>	<b>13</b>
Digital Electronics	X	X	X		X						X		X
Signal s & Systems	X	X		X	X								
Electronic Circuits I	X	X		X	X	X	X						
Electronic circuits II	X	X		X	X	X	X						
Communication Theory	X	X	X	X	X	X	X				X		
Electro Magnetic Fields	X	X	X		X		X						
Linear Integrated circuits	X	X	X	X									X
Control Systems	X	X		X	X								X
Digital Communication	X	X			X								X
Digital signal Processing	X	X	X		X							X	
Transmission lines and Waveguides													
Microprocessors and Microcontrollers		X	X		X								X
Measurements and Instrumentation													
VLSI Design			X		X	X	X					X	X
Antenna and Wave Propagation													
Wireless communication													
Optical Communication Networks		X	X								X	X	
RF and Microwave Engineering		X	X								X		X
Medical Electronics													
High speed Networks			X	X		X					X	X	
Advanced Microprocessors		X	X		X								X
Digital Image Processing	X	X	X		X							X	
Electromagnetic Compatibility and	X	X	X										

Interference													
Electronic system design		X	X		X			X				X	X
Mobile adhoc Networks			X	X		X						X	X
Wireless Sensor Networks			X	X		X						X	X
Satellite Communication		X	X	X		X	X						
Optical Networks			X	X								X	
Radar and Navigational Aids		X		X		X							X
Television and Video Engineering	X	X		X								X	X
Avionics		X		X								X	
Optoelectronic devices		X	X		X								X
Electron devices	X			X									
Circuit theory	X		X	X									
Electrical Technology	X			X								X	X
Engineering Acoustics	X	X	X									X	X
Multimedia Compression	X		X									X	X
Analog and Digital Communication					X					X			
Information Theory and coding	X				X				X	X			
Professional Ethics								X	X	X			
Total Quality Management								X	X	X			
Environmental science and Engineering						X	X	X		X			X

**Table 1 Courses Learning and Program Outcome Mapping**

Table 1 shows the Learning and Program Outcome Mapping of Electronics and Communication Engineering Subjects in Indian Engineering Universities. All Projects, Case Studies and assignments to the students must show the technical skills required with engineering ethics that should be embedded within the curriculum. The main goal of the Engineering Program is to make our students as Global engineer. Engineers Who opt for taking Teaching in Engineering Institutions and Universities should be given training in Principles of Education, Learning pedagogies, Effective assessment methods, how effectively deliver the contents etc in order to improve the quality in engineering education. The main drawback in implementation is the perception of students and faculty as well as Teaching towards Outcome Based Education. Outcome Based Education depends on heavily on Faculty that they deliver and share the knowledge effectively. Nowadays Evaluation like Final Semester Exams, Class test, assignments, and projects of academic related are now not enough assessment and we have to go many indirect assessment such as surveys of each course. Case study should be made with respect to Subjects and Present scenario of that technology concerned thereby ensures the student understands clearly the outcome process. As per analysis made here the students degradation is due to understanding and also possible influence on culture ingrained in the students. Finally for engineering education Laboratory works are essential tool for engineering education. So integration of Laboratory works in the curriculum for each subject must be in all the Indian Universities. The laboratory works are essential tools to enhance the students understanding of theories in engineering and technology education. Physical laboratory gives in depth practical training and simulation laboratory gives an idea to implement practically. Both are essential for the OBE results nowadays. In general traditional learning gives lesser practical exposure or using simulation tools, therefore process of transitioning from the content to outcome based learning gives vast improvement and clear understanding in the learning process. Problem based learning and integrated design Projects should be utilized in engineering OBE. . In OBE, one of the criteria is the inclusion of inputs from various stakeholders such as the industry, local governments, employers, alumni, parents and students themselves. This is different from traditional learning models whereby the assessment of learning becomes an end. In OBE, the learning process is a continual quality improvement

(CQI) process where the assessment of the learning outcomes provides information on how to improve the learning among the students.

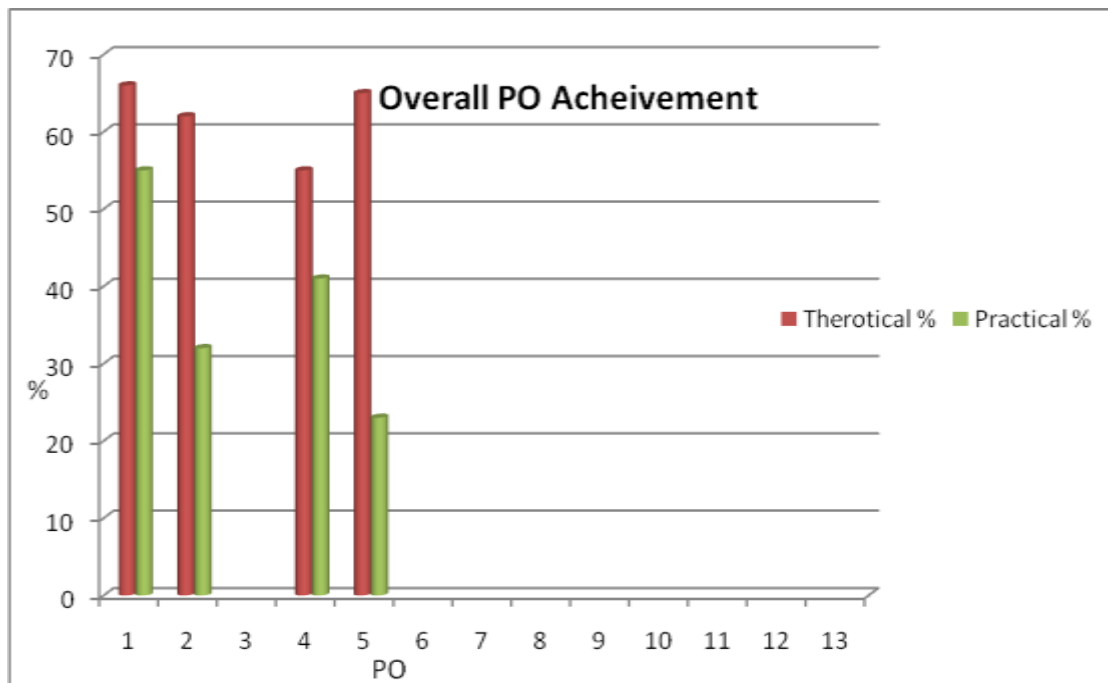


Figure 3 Overall PO Achievements for Signal System Course

The analysis on the assessment of the students' performance is reported in the End-Semester- for each course. A sample of the report for Signal Systems course is shown in Figure 1. The Learning and Program Outcome mapping for signal system course is shown in Table 2.

Sub	Final exam				Test		Others				
	Q1	Q2	Q3	Q4	T1	T2	Project	Assignment	Case Study	Seminar	Quiz
Full Marks	12.5 %	12.5 %	12.5 %	12.5 %	10%	10 %	10%	5%	5%	5%	5%
Strongly Achieved (80% - 100 %)	14	10	8	16	12	26	12	10	12	14	10
Achieved (50 - 79)%	18	20	16	16	18	12	32	26	24	28	16
Not Achieved (0 - 50%)	14	16	22	14	16	08	02	10	10	04	20

Table 2: LO – PO and mapping for signals and system course

For Signal and system course, the distribution of marks is given as Assignment (5%) which assesses PO (1) and PO(2), Project (10%) assesses PO (5) and (4), Quiz 1 (5%) assesses PO (2), Quiz 2 (5%) assesses

PO (1), Seminar assesses PO (4), Test 1 (10%) assesses PO (2), Test 2 (10%) assesses PO (1), Final Exam (25%) assesses PO (2) and Final Exam (25%) assesses PO (1); for a total of 50% assessment for PO (2), 40% assessment for PO (1) and 10% assessment for PO (5). The achievement of individual assessment for each student is analyzed and accumulated to give an overall PO achievement statistics as shown in Figure 1. The overall PO achievement indicates the percentage of students achieving the PO (a) as 55%, PO (b) as 32% and PO (e) as 41%, out of a total of 46 students. The achievement of certain Programme Outcomes can be improved via analysis of marks distribution breakdown. A Continuous Quality Improvement report must be submitted by the lecturer at the end of semester and recommendations for improving the course. The implementation of OBE in engineering education should produce engineering graduates whom are active learners responsible for their own learning, creative and resourceful enough to independently seek solutions to engineering problems. The student must understand the value of learning process and should have ability to manage on his own in achieving the desired outcomes.

## 5.0 Conclusion

Outcome based education is continuously improving process and assessment is only starting point to achieve the desired outcomes. The Proposed OBE will give new challenges and to improve the quality that can be utilized to develop educational model. The objective of learning and roles of faculty will ensure to buildup good educational model. This model should give active and engaging process to improve the quality of education in our country. This ensures the continuation of learning process and skills for getting the right students for right employment. The signal system course is an example to evaluate among the courses selected in Electronics stream. From the evaluation it is found that effective mapping of Learning Outcome – Program Outcome which can be utilized for evaluation of other subjects. When Majority of Learning Outcome – Program Outcome mapping is done the OBE can be achieved effectively.

## 6.0 Reference

- [1] www.princeton.edu, “Outcome based education”, accessed Sept 2013
- [2] EAC Programme Accreditation Manual 2012
- [3] A. Patil, C. S. Nair, G. Codner, “Global Accreditation for the Global Engineering Attributes: A Way Forward”, Proceedings of AaeE Conference, 2008, Yeppon
- [4] N. Savage, R. Birch, E. Noussi, “Motivation of engineering students in higher education”, Engineering Education, 2011, vol. 6, issue 2, pp 39 - 46
- [5] M. J Lawson and H.A. Williams, “Outcome based education”, Discussion Paper Prepared for the Association of Independent Schools of SA, Centre for the Analysis of Educational Futures, Flinders University, April 2007
- [6] L. Akhmadeeva, M. Hindy, C.J. Sparvey, “Overcoming obstacles to Implementing an Outcome Based Education Model: Traditional versus Transformational OBE”, Proceedings of Canadian Education Association, 2013, Montreal, QC, paper 145.
- [7] Goff, L., (2010). *Ontario Universities Council on Quality Assurance. Writing learning outcomes* [webinar]. [http://cll.mcmaster.ca/articulate/COU/Writing\\_Learning\\_Outcomes/player.html](http://cll.mcmaster.ca/articulate/COU/Writing_Learning_Outcomes/player.html)
- [8] Kemp, S., Martin, F., Maier, P., and Williams, I., (2008) A gap analysis of student employability profiles, employer engagement and work-placements, *Planet*, 21. 16-20. The Higher Education Academy Geography, Earth and Environmental Sciences (GEES).

- [9] Accreditation Board for Engineering and Technology (ABET), 2012. Criteria for accrediting engineering programs, 2013 - 2014. Baltimore MD: Accreditation Board for Engineering and Technology.
- [10] Andersson, N. and P.H. Andersson, 2013. Teaching professional engineering skills - industry participation In realistic role play simulation, Proceedings of the 6th International CDIO Conference, École Polytechnique, Montréal, pp: 15-18.
- [11] Ashman, P.J., S. Scrutton, D. Stringer, P.J. Mullinger and J. Willison, 2013. Stakeholder perceptions of chemical engineering graduate attributes at the university of Adelaide, CHEMECA. Newcastle City Hall, New South Wales, Australia.
- [12] Biggs, J. and C. Tang, 2007. Teaching for quality learning. 3rd Edn., McGraw-Hill International.
- Bodmer, C., A. Leu, L. Mira and H. Rutter, 2002. SPINE: Successful practices in international engineering education: Engineers Shape our Future IngCH.

