10. LEARNING OUTCOME BASED CURRICULA DESIGN FOR TOTAL QUALITY IN ENGINEERING EDUCATION

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Abstract

Engineering Education in India is experiencing a phenomenal growth and this growth is supported by the fact that there is huge requirement of trained and skilled manpower in the country & all over the world. Total Quality management can provide the umbrella to transform the quantitative growth into qualitative growth in engineering education . One of the vital pillars on which TQM stands is customer satisfaction & to satisfy stakeholders in education systems one of the significant factors is Teaching Learning process. In this paper, it is suggested to strengthen Teaching Learning process by focusing on learning outcome based curriculum design. A systematic approach to outcome based curriculum development will lead to student assessment, based on defined learning outcome which will drive learning in students. All efforts in any Technical Education Institutes is to enhance learning ability of students so as to lead to 100% placement of students in premier organizations to achieve Total Quality in Engineering Education.

INTRODUCTION:-

Engineering Education in India is experiencing a phenomenal growth and this growth is supported by the fact that there is huge requirement of trained and skilled manpower in the country, as well as, all over the world.

In the year 1947-48, the country had 38 degree level Institutions with intake capacity of 2500 and 53 Diploma level Institutions with intake capacity of 3670. The intake for postgraduate was 70. In the year 2000, the total size of the systems had increased to 4146 Institutions with approved intake of 544,660. These included 838 Engineering Degree Institutions with admission capacity of 2,32,000 students & 1224 Engineering Diploma Institutions with admission capacity of 1,88,000. Approximately two third of these Institutions were in private sector. Postgraduate education was being offered in 246 Institutions with admission capacity of 21,460 .

The real rise has taken place in the last decade with 348 Universities, 17625 Colleges and enrollment of 10.5 million students (Source UGC). This growth has achieved unimaginable success in meeting the quantitative need for higher education. But it has also made us think about qualitative aspect of education.

Some examples of lack of Quality in education today is -

- Improper budget
- Outdated Instructional methods
- Lack of in depth preparation for lectures, with

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- Lack of motivation and involvement of students in Class-room teaching
- Improper Assessment and Evaluation of students
- Want of Flexibility and up gradation of curriculum as per Industry or stakeholder requirement
- Inadequate skills in new students
- Inadequate campus placement of students

When we use the word Quality education the main focus is the Academic excellence through robust Teaching – learning process. It also involves commitment of faculty and continuous development through training, customer satisfaction., strategic planning to achieve the goals, measurement, analysis, and knowledge Management. All these parameters together will lead to quality education.

Total Quality Management in Technical Education

TQM is an all encompassing process that involves every person from non-Teaching office staff to technical and academic staff, it focuses on all organization activities, including teaching, researching, managing, assessing, evaluation of students etc. It's a total approach that encourages concentration on core activity of Institute when pooling in all efforts to embed quality with in the culture. Teaching is essentially to develop abilities in students and student evaluation and assessment criteria is what drives learning in students. Teaching-learning and evaluation of students are interrelated processes and are essentially directed by curriculam which comprise the core of Quality Education . Hence, TQM philosophy which focuses on Business leadership through customer satisfaction and employee empowerment when applied to various aspects of Technical education system essentially put emphasis on students, parents as well as employers as customers. If we have to delight the customers in Education system, achieving excellence in Quality of Education imparted is significant. TQM is essential to ensure that institutions perform well and that the customers of higher education are being well served.. Technical education system is recognized as service industry and greater emphasis is on meeting the expectations and needs of customers i.e. the students and other stakeholders. For the Institution to perform well, it is imperative to focus on all aspects of education system.

One of the important aspects for Total Quality in Education is curriculum design. For technical education, it's the curriculum which directs the teaching-learning process and shaping of any engineering graduate over a period of four years. Hence, if we implement outcome based curricula which focuses on student centered learning, it will provide a framework for more effective learning by shifting from content based 'instructional' paradigm to a learning centered paradigm.

Learning outcome based curriculum design will also strengthen Teaching Learning by clearly coordinating teaching and assessments with intended outcomes and providing all students with a clearly structured and accessible pathway for higher order learning.

Learning Outcome Based Curriculum Design

A curriculum is a systematically planned sequence of learning experiences. Curriculum design and syllabus structure defines the scope of knowledge, information, concepts, understanding skill sets, attributes etc, required to be delivered to the students over a defined period of time to make them suitable for supporting themselves in future for higher studies, employment, research or entrepreneurship in any course planned for. It also includes the evaluation pattern for students, number of lectures, practicals, study tours, working in small groups, private study, assignments to be given and exposure to a range of learning resources. Present methods of curriculum design focus on the knowledge

and information component along with the methods of delivery but do not specify what is expected from each unit or module in curriculum. Generally, it's the assumption during curriculum design that the outcome expected after the completion of particular unit is implied in the unit. If we adopt the learning outcome based curriculum design for Technical education it will surely give support to the good practice in teaching for teachers and learning for the students .Course curriculum decides the contents to be delivered to students, methodology of teaching and assessment criteria of students. If curriculum is designed as learning outcome based, it will give a defined outline to both the teachers as well as students regarding outcome of a specific unit taught by the teacher and clearly defined performance, capability attributes students should possess after completion of specific unit. It will also direct the students to know what will be the evaluation and assessment criteria to measure the learning outcome. It is said 'what gets measured gets done' and it has been observed that it is assessment which drives learning in students. Hence, clearly defined learning outcome will help students to know what will be measured thus will help them to choose the course accordingly.

When students focus interest on this systematic approach, it ensures that learning is acceptable and inclusive so that all types of students e.g. at risk students and socially disadvantaged can take interest in learning with an equal chance of success.

A systematic curriculum design approach follows these steps:

1) Identify intended outcomes and sequence topics as per syllabus.

2) Identify student characteristics -

   (a) Entry knowledge,

   (b) Goals & Motivation,

   (c) Socio Cultural characteristics.

3) Design learning sessions

4) Construct criteria supported assessment events to assess key learning outcomes

5) Implement and monitor the effectiveness of learning strategies and conduct a summative evaluation.

Systematic curriculum design gives an outline framework for a subject. This needs to be supported with systemic coherence and outcome based curriculum design for globally competent engineering graduates.

Systematic Coherence

Systemic coherence links curriculum with external expectations via graduate attributes that align with industry, society and higher education sector, and this needs in depth thinking and brain storming. To identify graduate attributes for an engineer in any engineering subjects, need to be externally and internally consistent with expectations from stakeholders. Systemic coherence links curriculum externally with social, industry, education expectations and internally consistent in terms of aims, outcomes, teaching and assessments. It also links subjects, horizontally & vertically, aligned with same level and higher level subjects. e.g. subjects like Applied Mechanics taught in first year is externally coherent with the Industry, education expectation in terms of developing problem solving skills, analytical ability, logical thinking, creativity etc. which is very much essential for an engineer and Applied Mechanics is internally consistent in terms of aims of this subject which is to introduce students to fundamental concepts of forces acting on a body and terminology to provide with a clear understanding of the effect of forces on the equilibrium conditions of the body. Outcome is to solve, apply the concepts of Applied Mechanics to various application in real life such as various forces acting on superstructure of a bridge ,analyse and find the effect of forces .Once the aim and learning outcome is defined for a

subject, it enables to align teaching and assessment with the intended capability change. Now, similarly aligning Applied Mechanics subject horizontally with same level subjects like Physics or Mathematics in first year and vertically higher level subjects like Strengths of Material, Machine Design etc. With systemic coherence, we get a clear road map leading to consistent building up a required knowledge, skill and attitude and helping all students groups to learn. Designing systematically coherent curricula will enhance teaching and learning. It will also emphasize the curriculum design which will focus on formulation of graduate attributes based on generic attributes. 3D global engineering graduate attributes suggested to empower students to obtain and retain employment or face any challenging situation are as shown below:-

1. Global attributes

2. Soft attributes

3. Hard attributes

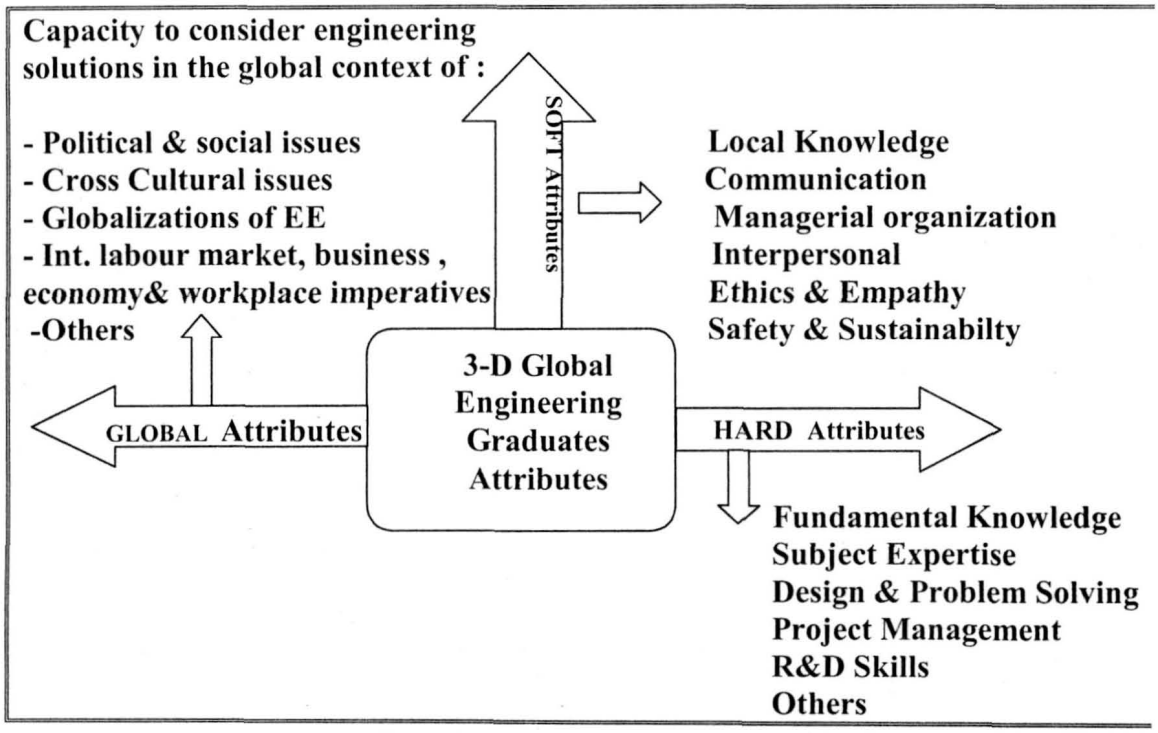

Fig. 1.1 Three D Global Engineering graduates attributes (Ref. Dr. Henk, Empowered learning International)

Writing Learning Outcomes

The best Learning Outcomes are descriptions of what the student will be able to do as a result of studying the course or modules. Learning outcome statements also express precisely what teachers want from their students to be demonstrated in terms of knowledge ,skills, values .

According to Allan (1994) learning outcomes in higher education encompass:

Subject based outcomes - which subsume learning objectives and which are complex discipline based outcomes which are capable of being assessed.

Personal transferable outcomes- including

acting independently, working with others, organizational skills etc.

Generic academic outcomes - information, thinking critically, analyzing, synthesizing ideas and information.

Intended learning outcomes are:

- Normally written in future tense
- Identify most important learning requirement keep the number of learning outcomes to 4 to 6 per module be achievable and assessable.
- Use language which students can understand.
- Related to explicit criteria for assessing levels of achievement.

Here, in this paper to demonstrate learning outcome based curriculum design, an example of one subject from first year engineering syllabus has been considered for discussion.

An example for Discussion

Subject – Basic Civil Engineering

Course level - First year Engineering (Second) Semester.

Unit-1:- Building Planning

Principles of planning, Introduction to Bye laws, building line, Space requirements, F.S.I. , Height of building . (Aspect, Prospect, Privacy, Grouping, Roominess ,Circulation, Elegance, Sanitation , Economy)

a) Out line / synopsis :

Planning is both an art and science for constructing sound, economical and elegant buildings (both residential & non-residential) & to create desired environment inside and outside of building is a must. The basic objective of planning is to arrange all the units of a building on all floors & at all levels according to their functional requirements making best use of the space available for a building. The building plan should take into account several factors such as climate conditions, site location, accommodation requirements, local bye-laws, surrounding environment etc. to make best use of available resources.

b) Learning outcomes:

On successful completion of this unit, students will be able to,

1) Understand principles of planning, means setting out the plan units of a building in such manner that the user of building enjoys the gifts of the nature, such as sun, rain, topography, etc.

2) Recognize the basic principles of planning for a simple residential building and apply it to building planning.

3) You will be able to draw a line sketch of simple buildings.

Unit-2:- Components of Building:

i) General idea about sub-structure, superstructure & their various elements & functions .

ii) Foundation: Functions, soil& rock types as foundation strata, Concept of bearing capacity, types of foundation i.e. shallow & deep foundation (Broad principles of their action & their suitability under different conditions)

iii) Superstructure :Principles of load transfer, frame action, load bearing wall action, composite action

a) Out line / synopsis :

A building is said to be 'Good' when it is structurally sound functionally efficient ,authentically good & economically affordable. In this unit an attempt is made to discuss & understand the requirements of building as a whole & requirements of various components of building in order to achieve functional efficiency in design.

b) Basic Requirements:

- The structure should be strong enough to resist design load .
- It must have sufficient stiffness so that its distortion doesn't offend the eye or reduce the efficiency of structure of its intended purpose.
- The building should be planned in such a manner that it provides sufficient comfort & convience to the occupants of the buildings.

c) Learning Goals:

Understand at conceptual level

- What is a substructure & superstructure?
- What is a foundation?
- What is a plinth?
- What is a wall?
- Why doors & windows are provided?
- What is a purpose of providing lintels & sills?
- Why weather sheds are provided?

d) Learning Outcomes

On successful completion of this unit students will be able to:

- You will be able to identify the components of substructure along with functional requirement.
- You will be able to identify various components of superstructure along with functional requirements.

Conclusion

This outcome based curricula approach is useful because, it makes explicit the design and assessment of units and of whole programmes; so students, examiners and quality assurance people know what is to be expected. This information will help students & teachers to enhance teaching-learning process thus improving the Quality of education in any Institute. Engineering Education Institutes are growing at very fast pace – Engineering graduate attributes require complex mixtures of knowledge, understanding skills & broaden capabilities like problem solving, team work etc. that can be more or less demonstrated and assessed. Generic skills are difficult to assess directly but these are an important part of a student's performance and need to be a part of curriculum design .Learning outcome based curriculum design if adopted can more precisely promote the learning that we want our engineering graduates to posses, to be locally and globally acceptable, leading to 100 % placement of students . To achieve total quality in education, one of the important parameters is curriculum design and if curriculum is designed as learning outcome based, it will enable the alignment of our teaching and assessment with the intended capability change.

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Our Grateful thanks to

1. The Chanceller, Bharatiya Vidyapeeth University for their sponsership
2. Amyo Technologies Pvt. Ltd, Aurangabad (for Advertisement)
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