

Role of Graduate Attributes in Curriculum Design to Enhance the Employability Skills of Graduate Mechanical Engineering Students in India

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Abstract

Graduate attributes for young engineering graduates are becoming very important to enhance the opportunity of their employability. Employers are interested in engineering graduates who have suitable soft skill, subject knowledge and technical skills to fulfill the demand of work environment. To fight with above challenges, there is increasing demand in engineering education to the integration of graduate attributes in the undergraduate engineering curriculum, so that engineering graduates must be able to solve/understand technical problems, communicate effectively, well in team work and have good IT skills.

This paper focus on designing of undergraduate mechanical engineering curriculum to enhance the employability skill.

Keywords: Mechanical Engineering Curriculum, Graduate Attributes, IT Skills

Introduction

A number of studies have been undertaken recently to determine the causes of unemployability of passing out graduate mechanical engineering students in India. How academia can better fulfill the requirement of engineering industry. Employers are looking for graduates, who possess good interpersonal skills, commercially aware and who can contribute to the business success of the organization. [1]

To fulfill the demands of industry, graduate attributes plays an very important role. These attributes must be integrated in curriculum of university's undergraduate program. The attributes demanded by industry are classified in two groups: technical knowledge & skills, and generic attributes. Technical knowledge & skills covers the theoretical and practical knowledge of core field of mechanical engineering. Generic attributes cover soft skills, personal attributes and values, which graduates should acquire irrespective of their area of study. [2]

Today we are living in a multidisciplinary era. Engineers are no longer singularly required to have expertise in a specific technical skill area only. Technologies are changing and the boundaries in and between science and technology disciplines are

blurring. Future engineers will have to be able to transcend disciplinary limitations, work in different fields, and master communication and intercultural collaboration skills [5]. Soft skills like Communication skills, team-working skills, integrity, intellectual ability and self-confidence are required by 80% of graduate recruiters as the five most important skills and capabilities sought by employers [1].

Graduate attributes are important factors in planning the curriculum of any university undergraduate program which bridges the gap between the mismatch of the skills students develop during their studies and the skills that employers need [2].

Universities have to redefined their curriculum to incorporate graduate attributes in teaching programs [3].

The Classification of Graduate Attribute

The attributes needed by engineers in their careers can be classified into:

- General attributes required by most employers from industry (e.g. communication skills, business skills, entrepreneur skill)
- Appropriate basic engineering subjects skills (e.g. mechanics, thermodynamics principles etc.)
- Attributes related to the career role (e.g. project management), and
- Knowledge and skills relating to the particular industry. [4]

In present era industrial sector and academics pays high attention to mechanical engineer having attributes related to subjects, communication, business etc. [6]

Graduates Attributes and Employability Skills

Graduate attributes have been defined as “the qualities, skills and understandings a university community agrees its students will desirably develop during their time at the institution and, consequently, shape the contribution they are able to make to their profession and as a citizen” [7].

When comparing descriptors of graduate attributes across many engineering institutions they commonly include professional discipline based knowledge, practice, and commitment. The employers have expectation that graduates have obtained discipline knowledge, and this has been a prime focus in university curricula. However, in addition to discipline knowledge the other graduate attributes are also becoming more important to enhance the employability. These attributes may be referred as successful attributes for engineer.

Successful Attributes for the Engineer

After the review of dozens research paper the shortlisted attributes for enhancing the employment opportunity are as follows:

- 1. Subject Knowledge:** Knowledge of mechanical engineering subjects, concept of science and fundamental of mathematics to focus on application involving analytical approach to resolve technical issues.
- 2. Problem Solving Ability:** Identify, formulate, analyze, and resolve complex engineering problems. Reaching substantiated conclusions using principles of mathematics, natural sciences, and engineering sciences.
- 3. Practically Ingenuity:** Responsible for laboratory requirement, maintenance, well coordination between lectures and laboratories. All experiments should be local industry driven.
- 4. Investigative/ Research Literacy:** The ability to design and monitor a research project. Use suitable methodology and solve complex problems in typical conditions. Awareness of current research within the research domain, and the ability of critical evaluation
- 5. Modern Tool Literacy:** Able to adopt, establish, and apply suitable modern engineering techniques, resources, and IT tools. Including prediction and modeling to complex engineering activities with an understanding of the tools limitations.
- 6. Communication Skill:** Communication is simply the act of transforming information from one person to another. It may be vocally, written, printed or digital media such as book, magazines etc.
- 7. Business and Management Skill:** Skills necessary to identify, evaluate, and begin new business enterprise. Able to include intellectual property, competition, strategy, business plans, technology forecasting, finance and accounting, and sources of capital for business development. A rigorous, quantitative approach is stressed throughout, and creates financial documents and plans, analyze human resource models, and work with sophisticated valuation methods, complicated equity structures, and legal and business documents.

- 8. Individual and Team Work:** Teamwork in the engineering profession is very essential to becoming a successful and well-respected engineer. Good working relationships with colleague can minimize the conflicts when working closely with other professionals on a project. Conflicts can arise from many sources but most relate to interpersonal, gender and cultural differences. Sourcing the code of ethics, “A practitioner must co-operate in working with other professionals engaged on a project”.
- 9. Social, Environmental and Ethical Awareness:** Environmental ethics helps define man's moral and ethical awareness toward the environment. Today, ethical and environmental awareness are key aspects of the working world and organizations look for graduates who understand core values and can act by ethical principles. This means engineers must be aware of relevant rights, environmental policies and virtues that impact on you area of work, and should understand what you believe in and what morals you want to live by. This is not only important for your professional life, but will also important in your personal development.
- 10. Flexibility, Agility, Resilience & Dynamism:** Curriculum cannot be to too narrow and only specialization oriented. That would limit general engineering skills necessary to adapt and adjust in the future.
- 11. Lifelong Learner:** Several self-study projects during four years should to introduce, requiring intensive research and literature survey in the library.
- 12. Global Citizenship:** Knowledge and skills, showing cross-cultural awareness, and respecting human diversity. The ability to work effectively and responsibly at macro level. Knowledge of global context on how disciplinary knowledge is understood and represented within other cultures. Cross-cultural capability beginning with an understanding of our own culture & and respects others cultures and customs. Actively engaging with issues of equity and social justice, sustainability and the reduction of prejudice, stereotyping and discrimination.

Mapping of Graduate Attributes:

With the help of feedback from students, experts, industrialist, national & regional issues and IQAC, create need assessment. Depending upon need assessment mapping

of graduate attributes takes place. Table 1 shows the mapping of graduate attributes in major subjects of undergraduate mechanical engineering.

Sl. No	Graduate Attributes	Major Subjects														
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	Subject knowledge	X	x	x	x	X	x	x	x	x	x	x	x	x	X	x
2	Practical Ingenuity		x	x	x	X	x	x	x	x	x	x	x	x	X	x
3	Communication Skills					X	x		x				x	x		x
4	Investigative/ Research Literacy	X	x	x	x	X		x	x	x		x	x	x	X	
5	Modern tool literacy		x	x		X			x	x	x				X	
6	Business and management skill								x	x				x		x
7	Individual and team work								x	x				x		x
8	Social, environmental & ethical awareness		x	x		X			x	x						
9	Flexibility, agility, resilience & dynamism															x
10	Lifelong learner	X		x		X		x	x	x		x	x		X	x
11	Global Citizen								x					x	X	x

Table 1: Mapping of graduate attributes

A→ Engineering Mathematics

B→ Applied Sciences Subjects

C→ Thermodynamics

D→ Strength of Material

E→ Material Sciences

F→ Engineering Graphics

G→ Theory of Machines

H→ Manufacturing Science

I→ Machine Design

J→ Machine Drawing

K→ Heat and Mass Transfer

L→ Refrigeration and Air Conditioning

M→ Quality Control

N→ CAD & CAM

O→ Product, Planning & Control

Depending upon the above table defining of program learning outcome will take place.

Learning Outcome

Learning outcomes are statements of learning achievement that are expressed in terms of what the learner is expected to know, understand and be able to do on completion of a unit (subject) or an entire course. These outcomes are aligned with graduate attributes, which describe the attitudes, behaviors, values and ethics built into the learning process. The program **learning outcomes** and associated **graduate attributes** guides the students on what will be expected by them.

Curriculum Designing:

The curriculum designing is a tool to ensure that the course has clear and understandable learning outcomes. Every unit in the course contributes to the students achievement of course learning outcomes (there is no overlap or needless repetition, and there are no 'gaping holes' in the course). Every unit in the course contributes to the development of appropriate higher order thinking skills, syllabus, clear and concise learning outcomes, tuition pattern (for example, workshops and tutorials), devised to assist students to achieve the outcomes; and manageable assessment tasks which directly measure the students' achievement of the learning outcomes. The curriculum designing process is based on the concept of the aligned curriculum and clear learning outcomes.

Conclusion

Due to the mushrooming growth in engineering colleges today's the quality of passing out graduate mechanical engineer have been declined. The industry today demands for trained engineer in design, development, quality control and marketing roles in large numbers. Formal training of engineers after requirement in basic technical frameworks and concepts is a key of success in the not-so mature Indian industry. Industries mostly avoid training due to its cost. Therefore engineering graduates have must have the skills which are required to be employable in the industry from the perspective of graduates attributes. Therefore it is highly needed to design the curriculum which match with graduate attributes to enhance the employability.

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