3. ASSESSMENT PRACTICES IN ENGINEERING - - A REVIEW

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Abstract

Higher Education in our country is being critically watched with great deal of expectations by all stakeholders. More so in the case of engineering domain, which not only is witnessing drastic regulation changes for aligning to global standards but also being sceptically criticised for quality adherence in a non-uniform proliferation scenario. All the regulatory bodies and the course providers have their mechanisms directed towards maintaining quality in engineering education-quality in terms of inputs, processes and consequently outputs. Grades, university ranks, placement records have been traditionally the direct markers for output of a course. These, however, do not completely signify the learning outcomes or the extent of transformation as an engineer, as vindicated by NASSCOM through their statistics of low employability rates amongst engineering graduates. Hence review is required to evaluate the current assessment practices, avoiding pitfalls or system errors which creep in due to familiar reasons, to cite a few-skewed growth in engineering education, shortage of qualified faculty, overemphasis on end-exam over education process, non-uniform quality standards due to environment pressures. These can be systematically eliminated, through greater awareness amongst the faculty to gauge effectively, higher ownership by the student towards learning responsibilities, separate assessment panels at college and university levels to constantly review the practices to increase the accountability. There is a greater need for the higher formations like Higher or Technical Education Commissions to carry out independent research studies to evaluate the learning outcomes over a target duration across the domains of knowledge, skills and attitudes.

Introduction

1. Higher Education in our country is being critically watched with great deal of expectations by all stakeholders. More so, in the case of engineering domain, which not only is witnessing drastic regulation changes for aligning to global standards, but also being sceptically criticised for quality adherence in a non-uniform proliferation scenario. Improvement in Gross Enrolment Ratios (GER), acceptance of Washington Accord as a signatory nation, global mobility of engineers, low employability status of graduates, mismatch between Industry-Institutes, skewed distribution between engineering branches, need of common entrance examination, paucity of qualified faculty, rural – urban variance, equitable opportunities, private participation in higher education, greater reliance on ICT, infrastructure availability, are some of the most hotly debated current topics. The central theme of all the debates unequivocally points directly or indirectly to quality of education.

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2. All the regulatory bodies, right from HRD in the centre to Higher Education or Technical Education Commissions in the States and AICTE, UGC, Universities to Autonomous or Affiliated Colleges, have their mechanisms directed towards maintaining quality in engineering education. Processes and procedures, curricula and covering methodologies are constantly reviewed and evolved, to meet the requirements. The requirements have become more focussed with the new semantic namely-Outcome Based Education (OBE). Assessment schemes are in position to gauge the extent of transformation or achievement of the objectives of the course. Grades, percentage of marks and placements, qualify the output and have been traditionally used as direct measures and periodic feedbacks from the students as an indirect measure of the competency of the graduate engineer. But these assessment findings, appear to be misleading, as, analysts confirm that many of the graduating engineers are unemployable, as vindicated by the statistics by NASSCOM and other major analysts. Therefore, a relook is required to understand the objectives, processes and inputs which lead to the transformation, before focussing to review the assessment practices and strategies to avoid pitfalls or system errors so as to implement an assessment system which gauges the transformation with adequate reliability.

Engineer and Society

3. The level of higher education, with engineering as one of its major components, has a strong bearing on the status of the society and the economy of a nation, as it is the source of trained and educated personnel. As per International Engineering Alliance, engineering is an activity that is essential to meeting the needs of people, economic development and provision of services to society.

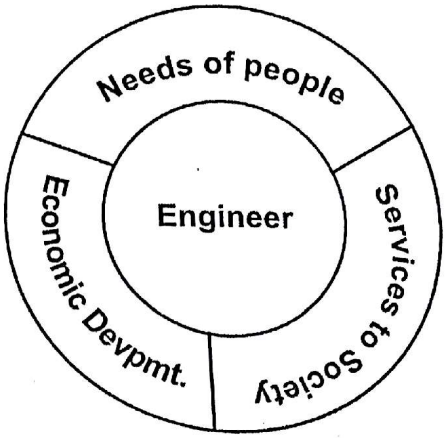

Fig 1. Role of engineer

4. Engineering involves the purposeful application of mathematical and natural sciences body of engineering knowledge, technology and techniques. Engineering seeks to produce solutions whose effects are predicted to the greatest degree possible, in often uncertain contexts. While bringing benefits, engineering activity has potential adverse consequences. Engineering, therefore, must be carried out responsibly and ethically, use available resources efficiently, be economic, safeguard health and safety, be environmentally sound and sustainable and generally manage risks throughout the entire lifecycle of a system. With these clear objectives, the programmes have to be designed so that the transformation of a secondary school pass out to a graduate engineer happens within the stipulated period.

Fig. 2: Time Chart for Transformation

Also the engineer grows from a graduate stage into as a professional and continues to learn and contribute lifelong.

Learning Outcomes in Engineering

5. The graduate engineer, if required to perform or behave as described, should possess specific attributes to a prescribed degree. The attributes when perceived as the learning outcomes of the transformation and their characteristics in terms of knowledge, skills and attitudes, can be broadly grouped as :

student going through this path or process should imbibe the attributes at the end of a specific engineering course. However, the obvious question every stake holder asks how successful are we in our efforts and how do we demonstrate the same? There arises the need for an efficient and effective assessment mechanism.

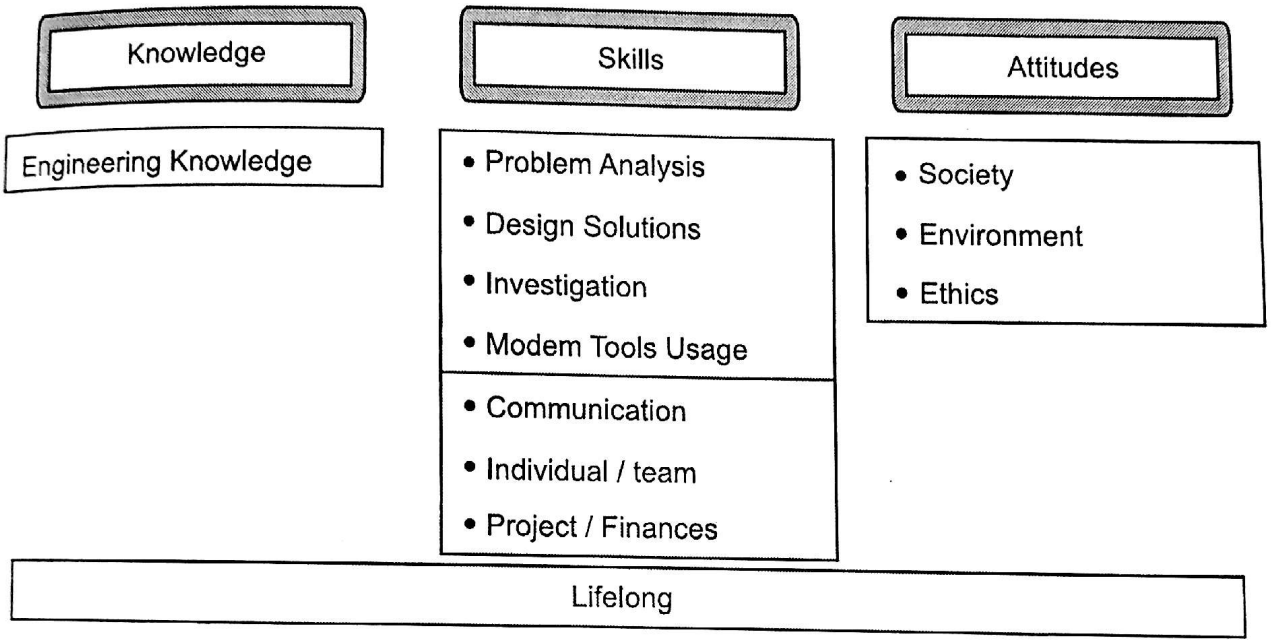

Fig 3. Domains of Transformation

6. For each group, the attribute or demonstratable competency needs to be stated for understanding, implementation and verification. For example for engineering knowledge, the attribute as per Washington Accord states that "*the engineer should be able to apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems*". Similarly for all the attributes the competency levels are specified in the Washington Accord. Once the goal or outcome is clearly defined, the path in terms of curriculum and time frames are set for a given starting point ie the higher secondary school or equivalent pass out. We expect that every

Current Status

7. Over the years, our engineering programmes have been using direct and indirect methods to assess the extent of achievement of objectives. The current practices in engineering disciplines are as given in Fig 4.

8. **Direct Methods** : Grades through the following methods fall under this category:

(a) Continuous Assessment through

(i) Mid Examination (subjective, objective)

(ii) Viva

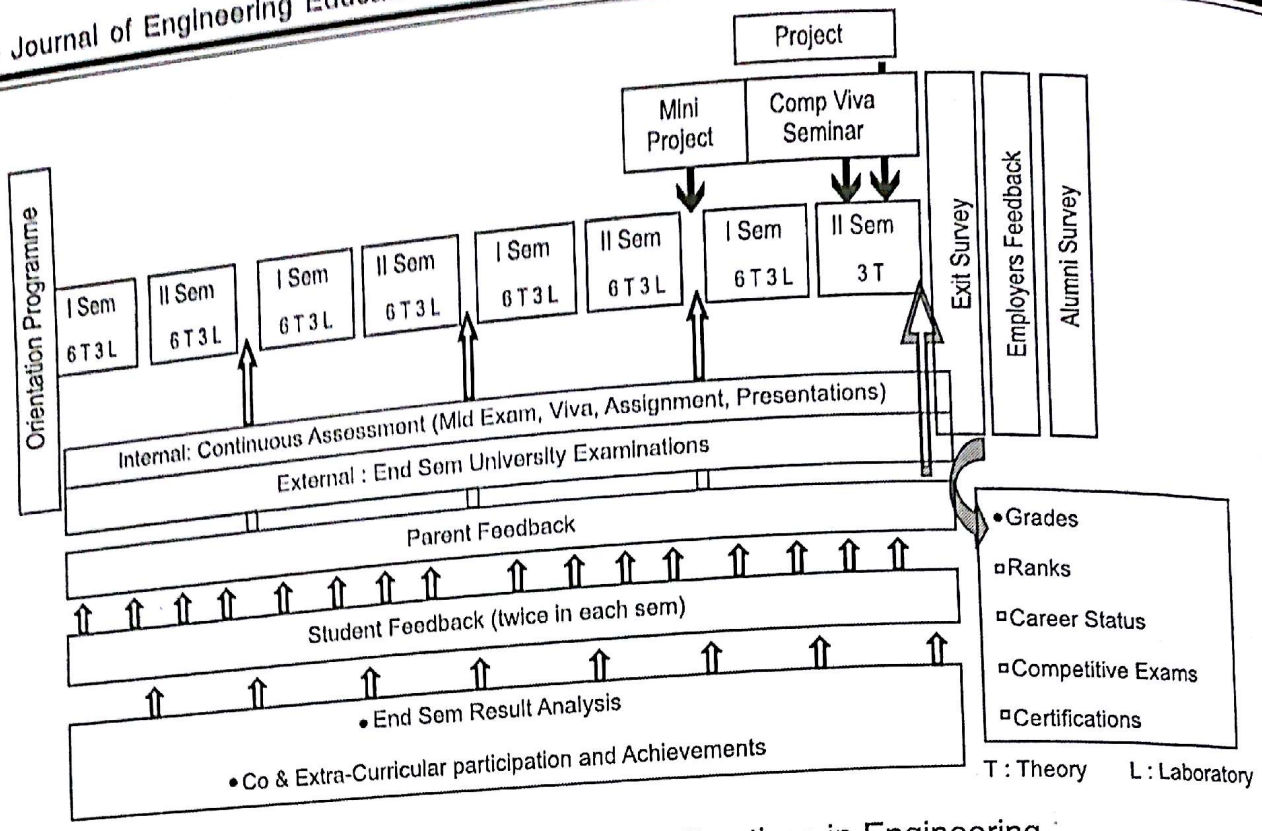

Fig 4. Current Assessment Practices in Engineering

(iii) Assignment

(iv) Presentation

(b) Terminal Assessment through

(i) Semester End Examination

(ii) Comprehensive Viva

(iii) Seminar

(iv) Project Seminar and Viva

Note: Continuous assessment may include unscheduled or surprise tests, where as terminal assessment is always prescheduled. The above methods appropriately applied to theory subjects as well as practicals.

9. **Indirect Methods** : These can be feedbacks from various stake holders. Typical methods with time frames are as given below :

(a) Orientation Programme (at the beginning of the programme)

(b) Student Feedback (at least twice in semester course coverage)

(c) Parent Feedback (at least once a year)

(d) Employers Feedback (after placement)

(e) Alumni Survey (at least once a year)

(f) Exit Survey (batch performance, university ranks, honours, recognitions, number and type of jobs, paybands, higher studies, start-ups, certifications)

(g) In-course Survey (semester result analysis, papers presented, seminars/workshops, co and extra curricular achievements)

Note: The evaluation of the above assessment is done by the institution concerned and by regulatory bodies at the time of affiliation, approval/ accreditation/ recognition.

System Errors

10. The results of assessment of any kind when assessment occurs, if not used or evaluated, leads to wasting valuable resources, failing to enhance institutional quality, reducing staff and student morale, and weakening institutional credibility. The same is true, if the

assessment methods are improper. The reasons for the departure may be due to environment, ignorance, time or other pressures, otherwise known as pitfalls or system errors, are amplified further.

11. **Direct Method Premise** : Direct methods rely on the presumption that availability of inputs indicate that the process has taken place at the end of the process period and the assessment results are direct indication of the extent of transformation or delivery of learning outcomes. The acceptable limit for the learning outcome is the minimum qualifying mark. Ideally, if the minimum qualifying mark is very close to the maximum mark, we have an authentic graduate engineer. In reality, the range gets broadened due to various environmental pressures, making the definition of quality of education a very generous statement.

12. **Indirect Method Evaluation** : The indirect methods need to be evaluated and used in correct perspective. Surveys and feed backs rely on statistical methods and are sensitive to the sample size, parameters, the mood and the integrity of persons involved.

13. **Input Assessment** : The transformation process, if viewed as a value addition to the learning, then the output varies based on the input of the students. The starting point of each student is based on curricula and other environmental factors and they are conspicuously different in our country. For example, the variation in terms of curricula and approach between the respective State syllabi and the CBSE, ICSE and other National or International flavours, medium of instruction being other than English, rural vs urban variations in attitudes, qualification criteria variation due to reservations, have due impact on input variation of students who opt for engineering qualification. These need to be addressed in the process through a proper input assessment. This information gives faculty members, and administrators crucial information for designing programs appropriate to the developmental needs of specific kinds of students and of individual students. Considering the numbers, this becomes an involved process, but needs special attention. In practice, however, input assessment is often scanty.

14. **Emphasis on End Point** : Assessments, no doubt, provide the necessary process pointers for the faculty and administrators in terms of where, what else, which way, how much more etc and also for the students a focus on the process and necessary course corrections. But ironically, the present system unknowingly encourages the importance of assessment points rather than the need to experience the process itself. Under these circumstances, the grades do not actually represent the outcomes as process is blurred with emphasis shifting to assessment method. Reorientation is essential, at the same time, the assessment is to be strengthened avoiding stereotyping.

15. **Adequacy of Assessment Method** : The methodology employed in assessment in higher education is diverse and must be appropriate to the purposes for which the assessment is being used. It should be reliable and valid. Reliability is the capacity of an assessment method to perform in a consistent, stable fashion during successive uses. Validity describes a condition where an assessment method, such as a paper-and-pen test, assesses what it claims to assess and thus produces results that can lead to valid inferences usable in decision making. For example, a classroom test claiming to measure higher-order thinking skill but actually assessing only memorized knowledge lacks validity. Viva-Voce method being replaced by objective question paper, to get over the time constraints or accountability issues, defeats the purpose of testing by word of mouth and communication ability.

16. **Faculty Preparedness** : The conduct of any process which include the instruction as well as the associated assessment (continuous or terminal) hinges on the preparedness of the faculty. Awareness of the transformation objective of the programme as a whole, or learning outcomes of the course or subject in particular

and the appropriate assessment method specifically by the faculty, is a much desired quality. Invariably, in university atmosphere, the faculty which conducts the instructions of the process, the faculty which provides the assessment scheme and the faculty which carries out the assessment, are different. Thus, the multipoint dependency demands focus from a wider group for the assessment process to be valid and reliable.

18. **Owning Learning Responsibility** : Swimming cannot be learnt by sitting on the edge of a pool nor from memorizing the technique from a book. The student should be prepared to jump into the water and accept the consequences. Students should be aware of the need and the process and own up the responsibility to learning for the outcomes or competencies by experiencing the process.

18. **Off-Campus Influence** : Secondary education witnesses a peculiar coaching centre phenomenon, which competes in parallel with recognized schools. This invariably shifts focus to the end exam from the actual education process. This psychological stance taken by students and parents as well, makes this a viable alternative even in engineering education. This leads to actual learning outcomes to be different from what is inferred from the assessment methods.

Role of Regulatory Body

19. Engineering colleges, majority being affiliated colleges, carry out the process as per the curricula designed by a University, by their faculty to students whose selection is through the respective state selection examinations. The assessment is a mix of internal and external, internal by the college and external by the university. Both experience system errors as indicated in the preceding paragraphs. The independent central establishments or autonomous colleges do enjoy more freedom in terms of curriculum designing, assessment methods, but have to fight the system errors. The awareness and insistence should flow from the University. Universities and the colleges do carry out evaluations of assessment methods as tasks under existing departments like Academics, Training and Placement. But, rarely they are published or made available at the university level as guide lines to the affiliated colleges under them. There is a need for Assessment Panels at University and College levels, which consciously review and evaluate the efficacy of the assessment methods.

20. There is a need for independent study of the assessment of learning outcomes by State regulating bodies like Higher Education or Technical Commissions in engineering as each state has all compliments like Central Institutions, State and Deemed Universities, Autonomous Engineering Colleges. For a set of related learning outcomes, a target group can be selected and they can be observed for a stipulated period, with the process variables and inputs being closely monitored. This can be made as an interesting study for the benefit of the evaluators as well as the engineering courses.

Recommendations

21. Awareness of the close relation between programme objective, the learning outcome, the transformation process along with its variables, input levels, environmental hygiene and the assessment should be understood by the faculty, administrators for the success of the transformation.

22. Valid and reliable assessment method is highly essential for intended learning outcomes. Assessment Method-Attribute Matrix combined with Subject – Attribute Matrix can finally yield an appropriate assessment method for each subject. The pitfalls or system errors, should be avoided while implementing the assessment method.

23. Multiple assessment methods lead to reliable results. The indirect methods and the independent studies can provide assistance to the grades for valid and reliable inferences which shall increase the confidence levels in a

transformation process.

Conclusion

24. Greater Gross Enrolment Ratio is good for the economy, and so the centre has set a GER target of 30% by 2020 from the present figure of a little over 12%. While preparing for the expected growth, engineering education should focus on the output quality, as analysts point out that greater employability is needed from the current engineers. A refocus is essential considering the outcome based education for global acceptance and mobility requirement. Hence, there is a greater need for systemic thinking and avoid the pit falls so that characteristics or attributes are demonstrated by the engineering graduates as per the programme objectives and can be verified reliably through valid assessment methods. The interrelations between all institutional components and functions have to be understood by all stake holders.

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