Strategies to Improve Engineering Education and Teaching-Learning Pedagogy in India

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Abstract–This paper proposes strategies to improve the quality of students pursuing engineering in India. The effective action required for improving technical education to make it effective not only to creamy layer students but also to the slow learning students pursuing education in engineering institutions are recommended in the paper. The current scenario of engineering colleges and learning trend of students is briefed. The idea of the paper to improvise technical education in student perspective is discussed which involves, activity based teaching-learning pedagogy. The idea of increasing to five years degree, which improves learning opportunities for slow learning students, is also proposed.

Key words - *Central Advisory Board of Education (CABE), Lifelong learning (LLL), Project Based Learning, Pedagogy*

1. INTRODUCTION

Technical education in India officially got thrust in 20th century with the set up of Constitution of Technical Education Committee of the Central Advisory Board of Education (CABE) in 1943 [1]. Later in 1945 the All India Council of technical Education (AICTE), a statutory authority was formed in order to uphold the standard of technical education.

The Ministry of Human Resource Development launched in December, 2002 the "Technical Education Quality Improvement Programme of Government of India (TEQIP)" which aims to upscale and support ongoing efforts in improving quality of technical education and enhancing existing capacities of the institutions [1]. AICTE has taken many initiatives to improve quality of technical education in the country [3].

The paper is organized as follows. Section 1 gives a brief introduction about the paper. Section 2 describes the current position of engineering education in India. Section 3 shows the factors affecting the quality of technical education. Section 4 states the proposed ideas to improve engineering education. Finally, section 5 is the conclusion.

2. CURRENT POSITION OF ENGINEERING EDUCATION IN INDIA

2.1 Increasing number of colleges and students' intake

Engineering and Medicine have long been the two most sought after careers for the students. However, these days engineering seems to be gaining ground. Students find engineering easy compared to medicine. Four years of engineering study at a reputed college fetches a decent job or might choose to go abroad for higher studies. Figure 2.1 shows the enrolment in Private and Government College [5].
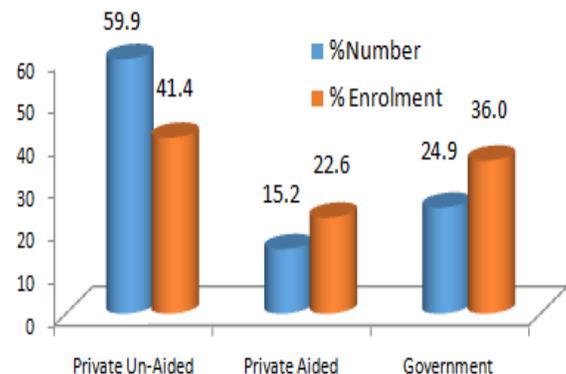

Fig- 2.1: Enrolments in Private and Government Colleges [5]

India produces around 1.5 million engineers every year. Of these, almost 40 per cent who search for a job for a year, while around 22 per cent take almost two years before getting a job offer, according to HR firms. According to a Nasscom's Perspective 2020 study, industry is already facing a shortage of employable talent and companies are hiring people who lack skills, but are trainable. An average company invests 16 weeks to train one employee in areas such as technical skills, soft skills, company orientation and process-specific domain skills. As a result, the training and recruitment cost of technology services companies has raised steadily in the last few years.

2.2 Students Employability status

With the help of ranks of colleges provided by realistic public surveys, top 100 colleges are separated from the rest of the institutions for comparison. As per the brief report [4], the employability status of the graduated students is shown in the table 2.1.

Table -2.1: Employability Percentage [4]

JOB TYPE	TOP 100 COLLEGES	OTHER COLLEGES
IT Products	20.23%	3.34%
IT Services	40.98%	17.40%
Design Engineer	25.41%	6.08%
Sales Engineer	38.85%	18.64%

The above table shows that the employability status is not that good in top colleges and very poor in other colleges. From this status, it is evident that unemployment is more in technical education which needs to be improved by implementing new strategies. Also the best utilization of existing methods is required to improve technical education.

Now-a-days the expectation of students is an immediate job, but they need to be aware of their talents, interests, strengths and weakness to be successful. Engineering studies is a dream for many students, as the field is lively and interesting where they can earn more. As per the press release on GATE 2015 results [6], released by IITK the statistics as shown in the table 2.2, the pass percentage shows the ability of the students and the quality of the knowledge they had gained.

Table -2.2: GATE 2015 Result Vs GATE 2014 Result [6]

Details	GATE 2015	GATE 2014
Total Registered candidates	9,27,580	10,33,625
Total Candidates Appeared	8,04,463	8,89,156
Total Candidates qualified	1,21,060	1,49,694
Pass %	15.05%	16.84%

Educators and the students require awareness of latest teaching-learning techniques specified by AICTE, the method of Mobile Education, Blended Learning and Lifelong learning. Blended Learning refers to a mixing of different learning environments. The phrase has many specific meanings based upon the context in which it is used. Blended learning gives learners and teachers a potential environment to learn and teach more effectively.

Students must understand the concept of Lifelong learning (LLL), which is "lifelong, voluntary, and self-motivated" pursuit of knowledge for either personal or professional reasons. As such, it enhances social inclusion, active citizenship and personal development, also competitiveness and employability. The term recognizes that learning is not confined to childhood or the classroom, but takes place throughout life and in a range of situations. During the last fifty years, constant scientific and technological innovation and change had had a profound effect on learning needs and styles. Learning can no longer be divided into a place and time to acquire knowledge (school) and a place and time to apply the knowledge acquired (the workplace). Instead, learning can be seen as something that takes place on an on-going basis from our daily interactions with others and with the world around us.

2.3 Current Challenges in Engineering

i.   The efforts to improve the quality of education in Indian institutions is challenging because many institutions cannot compete with few high end institutions in terms of resources at their control.

ii.

iii.   Derange in salaries and benefits of the teaching personnel. The local cost would have to be borne through enhanced fees from students making most of it unavailable to ordinary citizens. As the teachers are the primary source for creating such practices therefore their personal views are collected through prearranged survey questions from the two institutes [2].

iv.

v.   Teachers play a major role in improving the education and so life of every student. The number of dedicated faculties dropped off and the view of teachers about the profession has become just a job for salary, thus lacking in social responsibility. Learning and updating in education and technology is very essential for the teachers. Available time for the faculties for self improvement has gone down due to more clerical works given to them to be completed from time to time.

3. FACTORS AFFECTING THE QUALITY OF TECHNICAL EDUCATION

3.1 Quality of students admitted

Most of the students and their parents choose Engineering as their relatives or neighbors have suggested, but not because of the interest to learn the technology. The

students joining engineering colleges from rural background, lack in communication skills as they have completed schooling in their respective state languages. Those are usually inhibited in asking questions in class rooms. Therefore, faculty should be always accessible for their clarifications [2].

The student's expectation in education became marks oriented so that, quality and skills are not up to current real life situations. Practical learning from real life experiences should be taught along with the subjects. Ultimate aim of human life is to be peaceful and happy in any situation. Subjects like "Moral science and Human Values" should be taught as a subject with the existing curriculum.

3.2 Existing trend in teaching

Traditional teaching method is followed by most of the teachers using brick and mortar teaching method which is outdated. With availability of online facilities, these days, using black board and chalk method of teaching became obsolete and the students are not interested in being passive, listening for the whole hour. When the materials are available online, the students no more need to take notes in the class.

The research facilities and industry ready teachers are in scarcity and graduates of both Bachelors and Masters are lacking industry required skills. Also the traditional teaching learning methodology is outdated and best methods are to be identified and standardized to improve the required skills of the teachers and students.

3.3 Existing curricula and syllabi

Affiliated colleges bundled into a Technical University are choking the education stream [3]. Freedom of enquiry required for educating young minds is totally missing, and feedback from industries regarding the curriculum is not open to comment for any updates. Some core companies in Mechanical and Electrical stream very rarely recruit fresh engineers because of lacking in skills and direct understanding of the technology used in the industries and training time and cost of the company. Though the fresh engineers may be trained in the industry, still it is risky to involve them to work in complex machinery and electrical systems.

4. PROPOSED IDEAS TO IMPROVE ENGINEERING EDUCATION

4.1 Improving the learning trend of students

The ability of the slow learners could be taken in to account and a separate curriculum can be introduced for the below average scorers as a second grade curriculum, so that teaching and learning speed can be reduced and the number

of years of study can be increased in order to reach the understanding capacity of fast learning students. By doing this, stress and work load of those students can be reduced, improving their knowledge slowly. Because, it is not like a competition where only 3 persons win prizes, but it is life and career for every person. Some may score high and others may score very less or may fail. They need more time to learn, however everyone has to survive. So chance and time can be given for slow learners to pick up and pass in studies and career too.

A change in the curricula and syllabi is required, to make it current, forward looking, and dynamic [3]. It has been proposed that provisions required to be made for slow learners and students coming from the deprived sections of the society. While going about it the following are essential. This paper proposes that, Engineering Colleges could be categorized as follows:

A).Group I– Colleges with advanced facilities

B).Group II – Colleges with required facilities

C).Group III –Colleges with required facilities

Group I colleges offering Masters and Doctoral programs on their own. The creamy layer students usually opt for Group I top colleges. The 'Group II' colleges could be confined to offering Bachelor and master programs only but with a separate curriculum and 'Group III' colleges meant for slow learning students. The following are the proposed ideas of classifications shown for engineering course.

A). Group I - Advanced curriculum

*4 years B.E/B.Tech

B). Group II - Moderate curriculum

*4 years B.E/B.Tech

C). Group III - Moderate curriculum

*5 years B.E/B.Tech,

*4 Theory Subjects per semester &

*2 Labs per semester

The Group III, moderate curriculum is proposed especially for the slow learners. As the slow learning students require less workload and more time to grasp the information, they can prefer to join the Group III colleges. This would be very good alternative so that 100% students could be ensured to acquire the skills for the industries, higher studies, and entrepreneurs.

4.2 Educating the Educators

A teacher should be like an ocean of knowledge where the students can acquire more and more knowledge. Therefore, it has fundamental significance to train the college teachers' technical capacity and resource capacity. A better

idea would be to send the faculty members to industries to get trained in the required technology to transfer the knowledge to the students. The benefits of such a format would be valid for students to get placed in respective industry required technology learnt.

The teachers have to identify the gaps in their teaching-learning process and implement effective teaching pedagogy. It is imminent to explore ways to reflect the value of teacher education in technical skills training, renovating training results, making teachers actively apply the knowledge and skills learned.
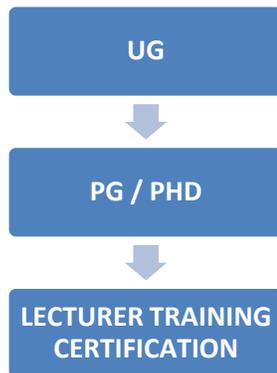

Fig- 4.1: Qualification of a Teacher

To achieve a better teaching quality, a standard certification of teaching methodology should be made compulsory for the teachers. The block diagram in the figure 4.1 shows the flow to be followed for teacher's selection process. The certification should be based on performance of theory examination and teaching demonstration. The latest teaching-learning methods need to be included in the certification course contents.

4.3 Teaching-Learning Process

We can no longer assume all students will achieve being taught the same way, and hence new teaching practices are required. The students should be taught about improving the listening skills and notes making methods. Also, the faculties should follow the same methodology to make the class interesting and give sufficient time for the students to make notes or hints.

Fig- 4.2: Proposed Collaborative Learning method

Some of emerging teaching learning methods include collaborative learning [8], blended learning [9], and project

based learning, etc. The proposed method for Collaborative Learning is as shown in the Figure 4.2. This method starts with group or cluster formation. The topics are to be taught in traditional method and using projectors. When a topic is covered, the students are allowed to discuss with the group members related to the topic. If any doubts after discussions, are to be cleared by the faculty.

The figure 4.3 shows the proposed method for blended learning. In this method, the students use the online resources and learn the given topic. Then they are allowed to discuss with the group members related to the prepared topic and can clear their doubts with the faculty.

Fig- 4.3: Proposed Blended Learning method

The process to be involved to implement the above teaching methods is

 i. Cluster formation

 ii. Toppers and slow learners mixed in each cluster

 iii. Allowing to discuss with group members

 iv. Student feedback and Result analysis

 v. Identifying gaps and continuous improvements

The "Show and Tell" technique is another form of the "Practical Examples" technique [7]. However, in this technique the role of the student is reversed to that of a teacher, thereby changing their perspective of the problem.

4.4 Proposed co-curricular activities

In education, we are witnessing the shift from teacher-centered education to student-centered education. Along with the technical skills, industries require graduates with managerial skills too. The courses in university undergraduate curriculum are outcome based and implementing the latest Bloom's Taxonomy on training students in a specific, and often specialized, skill or knowledge.

 i. Implementing project lab From II year onwards

 ii. Setup Entrepreneurship cell and incubation center

 iii. Collaborative research projects involving students

5. CONCLUSIONS

Thus, for a real challenge of improving technical education, we have to make sure that the educational system is truly aware of the psychology of the slow learning student's experience. Work hard to prevent the peer ridicule that too often results from academic excellence. Now, choice based credit system is a very good initiative which is encouraging to students to choose their interested subjects, but as proposed in this paper, the number of subjects can be reduced for the ease of slow learners. Also, apart from the regular lab exercises, application related designs can be included in the laboratory with the teaching learning process. There are many other methods to improve the teaching-learning experience, but not limited. Innovations on methods of teaching, considering the different criteria like analysis on students learning style, environment, available resources, etc are much required considering the future technology. All the faculties need training on course curriculum development, instructional design methods, etc for encouraging active learning and outcome based education.

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BIOGRAPHIES

Surenderkumar.S completed BE (EEE) in the year 2004 in Maharaja Engineering College, Coimbatore, TN, India, worked as a PCB CAM Engineer for 3 years, and then completed ME (Applied Electronics) in the year 2011 in Anna University Regional Centre, Coimbatore. Working as an Assistant Professor from 2011. Interested in microelectronics, innovative teaching methods and student-centric, outcome based Education.

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