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Measures for Improving Undergraduate Engineering Education: An Emperical Study in the state of Karnataka

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----------**ABSTRACT**----------

Engineering education in India has grown in leaps and bounds in the recent past but this growth has not resulted in improved employability of engineers passing out. In this context study was undertaken in seven engineering colleges of Visvesvaraya Technological University in Belagavi region of Karnataka to find out the measures for improving undergraduate engineering education and to prioritise these measures. Two major groups of respondent's viz. the engineering teachers and the final year engineering students of engineering stream were interviewed by the authors to solicit their views to improve employability of engineering graduates. Based on these interviews and discussions the various suggestions given by the respondents were narrowed down to nine important suggestions with wider acceptibility. Subsequently a structured questionnaire was prepared and the respondents were requested to rank these nine measuress from their view point based on their experience and value judgement. The study covers responses from sixty engineering faculty from seven of engineering colleges in Belagavi region. These responses were compiled using tally marks and analysed using weighted average method. The faculty responded that the student engagement in learning process by various means viz. seminars, assignments, mini projects for every subject throughout the four years should be the first priority. This was followed by the need for teachers to be proactive learners with annual training and their involvement in publishing journal papers

Keywords *- Engineering Colleges, Engineering Graduates, Engineering Studies, Employability, Belagavi*

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I. INTRODUCTION

The Engineering education in India has grown in leaps and bounds in the recent past. AICTE under MHRD is overlooking the engineering education in India which covers all the engineering colleges. However this growth has not resulted in improved quality of engineers passing out but rather has brought down the quality and hence the employability of fresh graduates. One reason attributed to the decline in quality is the increased passing percentage of students appearing for the academic exams. In the 80^s and 90^s the passing out percentage was far low compared to the present trend. Added to this we find most of the fresh engineers passing out from universities securing first class with distinctions which does not reflect the true potential of the student. Keeping this in mind a study was undertaken to find out ways and means to improve the employability of engineering graduates by conducting an organised and well structured study. Karnataka has 202 engineering colleges being affiliated to the Visveswaraya Technological University located at Belagavi and having its regional offices at Belagavi, Bangalore, Mysore and Gulburga [1]. The Belagavi region of VTU covers 30 engineering colleges with maximum number of colleges located in the district of Belagavi itself. The weighted average method for ranking has been used [2].

W.P. Lewis & E. Bonollo (2002)," found Experimental evidence on the design skills and professional behaviour valued by design practitioners and managers is presented and reviewed in the context of an operational model of the design process. Implications for design education and research are discussed. In the light of this discussion a procedure advocated by many educational researchers for assessing the quality of university education is critically examined, and found not to meet the needs of professional disciplines. Vasantha Aravinthan [4] indicated that due to changing times there is need for flexibility in assessment of the engineering education. Designing assessment schemes for higher level technical undergraduate courses in engineering is a challenge nowadays, especially in a changing educational environment. With more emphasis being placed on flexible learning modes and flexible assessment schemes, examiners are confronted with the review of the existing assessment schemes for the courses they teach.

Traditionally, having a combination of assignments and examination has been the most popular method of assessments designed by course examiners. Isabel Huet [5] finds that there is considerable educational literature to suggest that the way universities conceive and manage the relationship between research and teaching, impacts negatively or positively teaching practices and student learning in Higher Education. Although the relevance of linking research and teaching is perceived as of central importance by many authors and university leaders, empirical findings suggest that research does not always influence the teaching quality and vice versa.

Soner Şeker, (2013) discusses the role of computer-aided learning (CAL) in engineering education and some descriptions about computer aided learning were explained. He finds that in recent years, the positive results are seen about the use of computer aided learning in engineering education. Computer-aided design (CAD), computer aided manufacturing (CAM) and computer aided engineering (CAE) is becoming increasingly popular. Therefore, computers have become very essential for applications in engineering and in engineering education [6]. Computer training and computer assisted instruction should be expanded. Engineering educations goal is to develop design capabilities and computer-based training is the best tool for this purpose. Juan A. Méndez, Evelio J. González (2013) state that the goal of the work is to improve the teaching–learning process through the inclusion of prediction features in a control system proposal namely Reactive Blended Learning. To achieve this goal, a model of the student has been proposed by them, whose considered outputs are the performance and a participation index that measures the activity level of the student in the class [7].

Riyad Abdel-Karim, Samir H.Helou, (2013) studied engineering education in Palestinian Universities which are playing a pivotal role in fulfilling the demand for skilled personnel who are cornerstones in the present state building endeavour. They find that Palestinian Universities are burgeoned fast with whatever adversities that accompany uncontrolled growth. Tertiary education under the jurisdiction of the Ministry of Higher Education follows a 12- year of schooling programs. Higher education is hitherto limited to undergraduate studies albeit some select programs extend into advanced degrees [8]. Research activities after graduation are minimal due to the absence of a national research focus. They find that expertise of international standards is obligatory for producing resilient and intellectually mature human capital is the goal. Engineers being a politically influential group are slanted to face the challenges of globalization. They shoulder the onus of contributing decisively towards the socio-economic development of the emerging state. However, the lack of parity between market demand and engineering graduates creates yet another problem of an abhorring dimension. The repercussions of such phenomenon should be dealt with effectively.

Wisuit Sunthonkanokpong, (2011) studied the future global visions of engineering education. Due to the socio-technological challenges, engineering education must anticipate and adapt to dramatic changes in terms of engineering practice and instruction. In the future, the roles of engineers must change along with the following aspects: the globalization of industry and engineering practice, the shift of engineering employment from large companies to small and medium sized companies, the growing emphasis on entrepreneurialism, the growing share of engineering employment in nontraditional, less-technical engineering work, the shift to a knowledge-based "services" economy, and increasing opportunity for using technology in the education and work of the engineering [9]. This study found that successful attributes for the engineering education graduates in 2020 must be at strong level. They are as follows: lifelong learners, ability to frame problems, putting them in a socio-technical and operational context, dynamic/agile/resilient/flexible, high ethical standards and a strong sense of professionalism, good communication skills with multiple stakeholders, possess strong analytical skills, exhibit practical ingenuity; posses creativity, and business and management skills, leadership abilities. Moreover, the study found that the problems which engineering education graduates in 2020 encounter and have strong ability to solve. They are as follows: maintaining technical currency & life long learning, environmental and energy related problems, managing globalization, problems related to population growth, ultra-nanoscale, miniaturization and bioengineering and medical problems.

Ashish Kumar Parashar, Rinku Parashar, (2012) relate teachers' conceptions and beliefs to their teaching practice, acknowledging contextual and cultural aspects of this practice. They analyse the Indian education sector which reveals the challenges of incoherence in policy formulation and implementation. The paper reviews aspects of curriculum process such as policy, analysis, objectives, content, evaluation methodology and implementation. Therefore, the need for transformation in curriculum for all the engineering educational and higher education levels becomes necessary. The paper submits recommendation on further enhanced strategies that will help in the development of education in line with modern trends in curriculum issues [10].

The above studies were undertaken abroad and no specific studies have been conducted for engineering education in the state of Karnataka. The best way to get the details was from the faculty in technical institutes who are qualified engineers themselves and have years of experience both in industry and academia.Hence this study is an attempt to critically find out the various measures for improving engineering education and rank the various measures based on empirical study.

II. METHODOLOGY

Belagavi district in Karnataka hosts the sole technical university for the state of Karnataka to which all the 202 engineering colleges are affiliated except National Institute of Technology Suratkal and University Visvesvaraya College of Engineering Bangalore. Out of the 202 engineering colleges in state 30 engineering colleges are located in Belagavi region and the Visvesvaraya Technological University (VTU) is located in the city of Belagavi. VTU established in 1998 is leading technical university in the nation which has successfully integrated the various colleges and universities to come out with a common curriculam and schedule of teaching and assessment of technical education. VTU is a very young and innovative university which has ventured into many tie ups with foreign universities and has the following establishments. VTU Bio-Fuel Information and Demonstration center at Belagavi, VTU center for Nanotechnology at Bengaluru, VTU National Academy for Skill Development at Dandeli in Uttar Kannada District, Parisar Chair at Belagavi, VTU Innovation Clubs at VTU and in Affiliated Engineering Colleges. , VTU Institute of Advanced Technologies at Muddenahalli, E-Learning Center at Mysuru, and VTU Bosch Center of Competence at Mysuru

Authors themselves are teaching in one of the engineering colleges in Belagavi region. Both the authors have over two decades of experience which includes industrial experience as well as academic experience. The authors have exposure to all the engineering colleges and their faculty in Belagavi region as they are actively involved in all sorts of examination duties of the VTU. Hence the consultation process to solicit the responses from the respondents could be undertaken physically. Based on the discussions with the faculty of mechanical engineering departments the nine measures with the maximum acceptance were considered. Accordingly a questionnaire was prepared to enable the respondents to rank these nine measures based on their experience and perception. The entire process of administering the questionnaire and collecting the responses in seven different engineering colleges was conducted by physical one to one interviews after due briefing process. The analysis of the data was carried out using weighted average method in MS Excel. The details of the faculty respondents are as follows.

Table 1 Respondents details

Total Experience of 60 faculties	723 years
Total Industrial Experience	148 years
Total Teaching Experience	575 years
Average age of respondent	37 years
Average Experience	13 years of experience (3 Indl. +10 Teaching)
No. of Colleges studied	07
Total respondents	60
Rural Respondents	27 (45% of total respondents)
Urban Respondents	33 (55% of total respondents)

Table 2 The nine measures suggested by the respondents

a	Biometeric attendance for students to be introduced with direct link to university for recording & maintaining attendence records of students to decide on eligibility for final University examinations
b	Inplant training of students in industry for a minimum of 20 weeks during their four years of engineering education
c	Mandatory requirement of digital class rooms,ensure internet connection , LCD projector with PC
d	Annual calibration of all laboratary equipments by third party to ensure effective maintenance and proper functioning with correct readings
e	Theory subjects should be related to the real time requirements of Industries & updated regularly
f	Teacher need to undergo training of 2 weeks annually & publish 1 paper in international/national journal per annum to update themselves
g	Teachers need to be trained as an when syllabus is revised
h	Syllabus to be revamped with greater importance for numerical subjects with extra teaching hours than regular subjects
i	Student's engagement/ participation mandatory in the form of 1 Seminar per subject per semester in the form of Power Point Presentation (PPT) and evaluation records to be maintained. University needs to make it mandatory to encourage student engagement

III. RESULTS AND DISCUSSIONS

The details of various measures viz "a" to "j" are as described in table 1 above. The overall results covering the nine measures and their weighted averages from rural, urban and total faculty are as shown in fig. 1 below. Based on the total weightage of the respondents the rankings are provided.

Fig. 1 clearly shows that the measure i with an overall score of 0.13 is the top ranking measure which speaks of student engagement. Due to rapid explosion of internet the student community has greater access to information and is thus less dependent on faculty for the current information. The respondents strongly feel that by active participation of students and increased involvement of students, the teaching learning process can be improved. The present set up by the university has the scheme of PPT per subject per semester for post graduate students which can be implemented for undergraduate students in future. Further student engagement measures can include assignments, quiz programmes, technical events in campus, mini projects, group activities etc which shall ensure that the students spend more time and energy in technical studies.

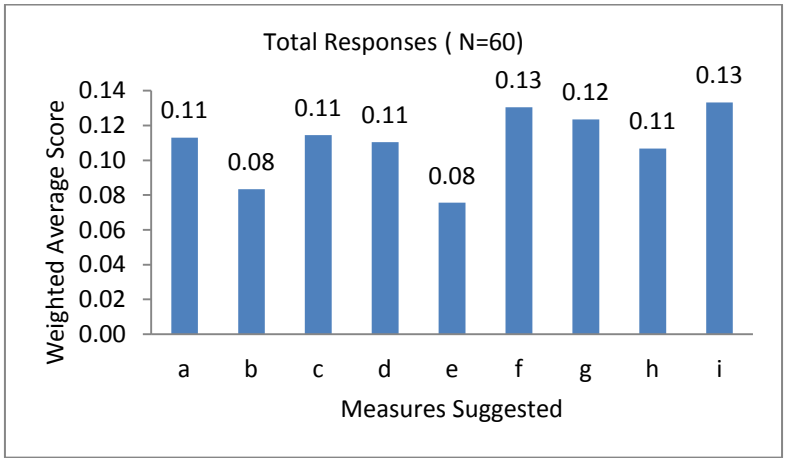

Fig. 1 Responses from faculty in engineering colleges

The second measure with highest score was "f" i.e. learning perspective of teaching fraternity, to ensure they are exposed to the real world and are in tune with the recent developments pertaining to their field of academic interests. The world is undergoing wide ranging changes in most of the technologies at a rapid pace and hence the rate of obsolescence is very high. The students expect their faculty to be in tune with the current happenings so as to make the teaching process more informative and attractive. The universities update their syllabus at regular intervals and VTU does update its UG syllabus every four years and the latest revision being undertaken in the year 2014. The faculties of all the affiliated colleges are sent the draft syllabus for their comments but no personal meetings or interaction is convened to enlighten the faculty of the new additions. Meetings of respective subject faculty over the revised syllabus can be convened for percolating the spirit behind the revisions.

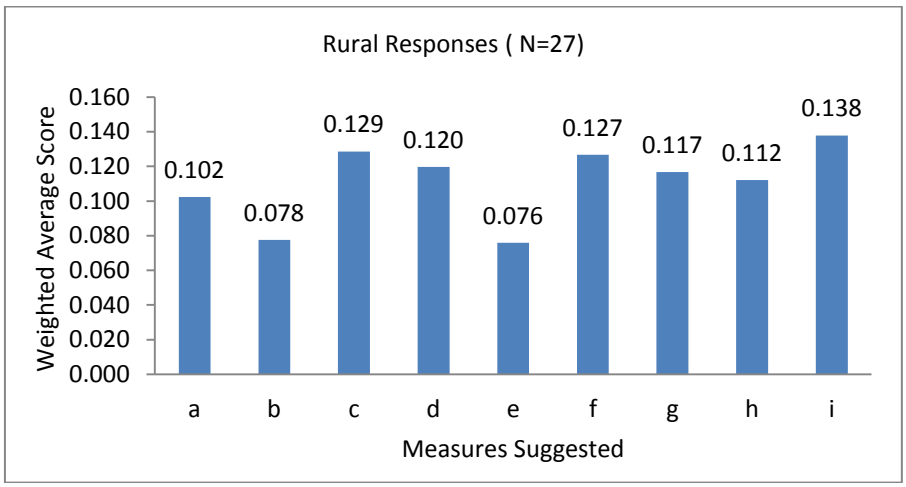

Fig. 2 Responses from faculty in engineering colleges located in rural areas

Fig. 2 has the highest rating for measure 'i" with a weighted score of 0.138 followed by "c' with a weighted average score of 0.129 ie the teaching aids. The responses from rural engineering college faculty indicate the second highest priority for digital teaching aids such as LCD projectors, internet access, PCs for effective teaching. This can be attributed to the poor teaching aids made available to them in rural set up.With the percolation of technology its high time that these institutes update their teaching aids to ensure better learning experience for their students. With the internet explosion the teaching fraternity finds that using internet makes learning and teaching easy and effective. The rural faculty also seconded the measure of upgrading their knowledge as and when the syllabus is revised.

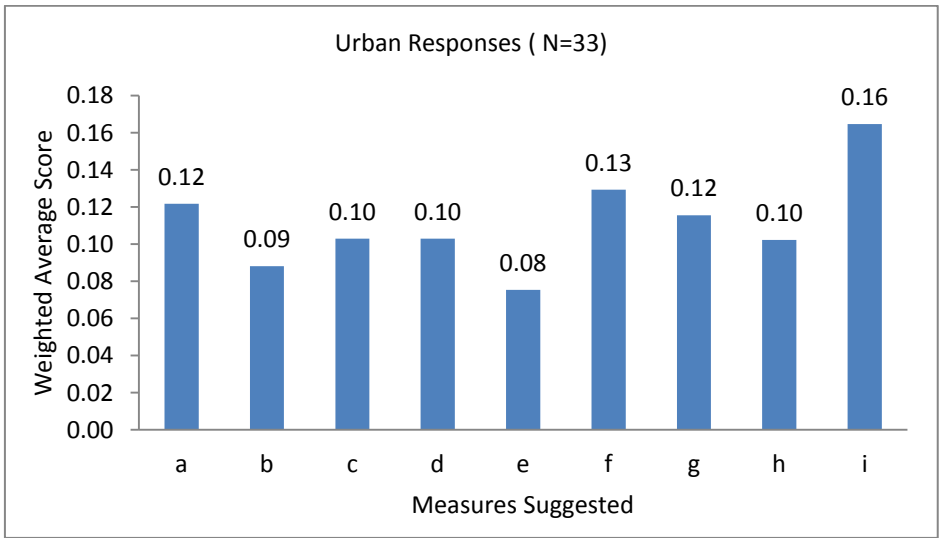

Fig. 3 Responses from faculty in engineering colleges located in urban areas

Fig. 3 clearly shows that the measure i with an overall score of 0.164 is the top ranking measure among the urban faculty which speaks of student engagement as the top most measure to improve employability of engineering students. Students in cities have more distractions and very little attraction towards studies. Hence students need to be constructively engaged to ensure that they spend greater time and efforts in learning technical concepts and improve their learning curve.

Table 3 Nine measures as ranked by total respondents

Abbreviation	**Measure**	Rank
i	Student's engagement/ participation mandatory in the form of 1 Seminar per subject per semester in the form of PPT and evaluation records to be maintained. University needs to make it mandatory to encourage student engagement	**1**
f	Teacher need to undergo training of 2 weeks annually & publish 1 paper in international/national journal per annum to update themselves	**2**
g	Teachers need to be trained as an when syllabus is revised	**3**
c	Mandatory requirement of digital class rooms,ensure internet connection , LCD projector with PC	**4**
a	Biometeric attendance for students to be introduced with direct link to university for recording & maintaining attendence records of students to decide on eligibility for final University examinations	**5**
d	Annual calibration of all laboratary equipments by third party to ensure effective maintenance and proper functioning with correct readings	**6**
h	Syllabus to be revamped with greater importance for numerical subjects with extra teaching hours than regular subjects	**7**
b	Inplant training of students in industry for a minimum of 20 weeks during their four years of engineering education	**8**
e	Theory subjects should be related to the real time requirements of Industries & updated regularly	**9**

The overall results of the sixty respondents towards the nine measures are depicted vide table no. 3 and fig. no 4. The top ranking of urban repondents is echoed in the overall top measure i.e. "i" with a score of 0.16 followed by measure "f" with a score of 0.13 which has been agreed by both the urban and rural respondents. The results clearly indicate better engagement by students and faculty to achieve the desired goal of quality technical education. Measures should be developed for the quality engagement of faculty and students and should reflect in the academic calender of the institutions. Proper mandate need to be prepared based on the resources and other constraints by the institutions for the teaching as well as laboratory instructional faculty to ensure professional growth of the faculty.

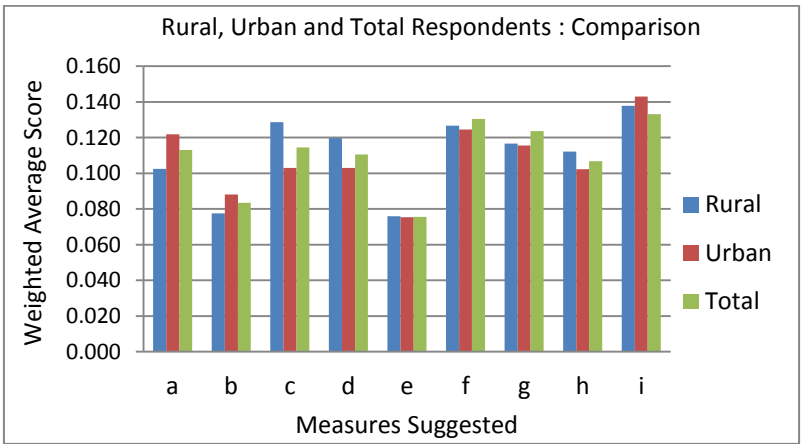

Fig. 4 Responses covering both rural and urban engineering colleges

The responses of rural and urban faculty are by and large quite similar for all the nine measures as seen from fig. 4 above

IV. CONCLUSION

The results lead to conclusion that learning is student centric and the students need to put in greater efforts to acquire requisite skills. The four years of undergraduate engineering education need to be effectively utilised by the student community to improve technical knowledge of todays engineering world as well as soft skills to ensure better employability. Due to internet explosion and affordability and accessibility the students have greater access to internet but that is to be channelized for acquiring latest technical knowledge and having better clarity on the subjects.

The engineering colleges located in rural areas need technical inputs in the form of teaching aids such as PC, LCD projectors and internet facility to ensure better teaching and learning process. The teaching fraternity should go by the addage "Those who dare to teach: cannot cease to learn" and thus actively involve in research and technical conferences. The authors had extensive face to face interaction with eleven promoters of mechanical industries in the north karnataka region and found that they also consider the two findings viz. student engagement and faculty updation a measure crying for attention

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5. Maratha Madal College of Engineering, Halbhavi, Belagavi District
6. Hirasugar Institute of Technology, Nidasoshi, Belagavi District
7. VSM Institute of Technology, Nippani, Belagavi District.

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