A Study of Technical Education Quality with Focus on the Four Year Engineering Course with the Objective of Identifying Areas of Improvement

Jitendra Shreemali
Associate Professor
Sir Padampat Singhania University, Udaipur, Rajasthan

Dr. Sudha Bhatnagar
Post Doctoral Fellow of ICSSR
Dept. of Sociology, MLSU

Abstract

Higher education in India has grown enormously, both, in terms of number of institutions and students. This growth has been particularly more rapid in this century compared to the previous fifty years since independence. This growth is also accompanied by an unprecedented growth in number of private institutions in higher education. Questions about the quality of various higher education institutions in India have cropped up and this study attempts to answer one of those questions: Are students undergoing higher education in the technical field of engineering satisfied with the degree programmes they are undergoing and its different aspects. Only final year students of the four year degree engineering programme were selected for this study as they have had the best exposure (among all students) to the entire programme. A standard tool of student feedback was selected for collecting data using convenience sampling and the data statistically analyzed for a level of significance of 5% ($\alpha = 0.05$).Respondents were assured of confidentiality of their identity and that of their institution. The sample size was 41. The study used rather modest criteria of majority of students agreeing or strongly agreeing on the characteristic/feature of the four year degree course. The study establishes that even with this modest standard majority of the students were not happy with (a) Instructor Enthusiasm during Degree Programme; (b) Group interaction and exchange of ideas/knowledge; and (c) Breadth of Degree Programme. A higher standard requiring that 75% of the students give a rating of 'Agree' or 'Strongly Agree' would have led to the research concluding that, on none of the characteristic feature of the questionnaire, did the degree programme meet set standards. This presents a rather bleak picture of the quality of technical education in question.

Keywords:

Higher education, Technical education

Introduction

Indian Higher Education has expanded enormously since independence in 1947 with the most rapid phase of expansion beginning in early part of this century. PwCPL Publication (2012)

discusses the growth in Indian higher education sector with the CAGR in number of Universities plus University level institutions from 2004-05 to 2011-12 being over 10% and CAGR for number of colleges from 2004-05 to 2010-11 being close to 12%. In terms of number of students enrolled, India stands third after China and USA. Hajra and Thakkar (2011) estimate the Indian private education to reach USD 45 Billion by 2015 with the yearly education spending by government and households in India at USD 600 Billion being larger than that of the US at comparable prices. The main components of the USD 45 Billion private education includes the following components: pre-school (USD 3 Billion), coaching (USD 8 Billion), technical education (USD 12 Billion) and K-12 (USD 20 Billion). World Bank Report No.78182 (2013) highlights the increased access to technical education in India with the number of engineering institutions in India having grown from 1500 in 2006 to 3400 in 2011 and catering to about 1.5 million future engineers as compared to about 570 institutions giving engineering degree in China, about 360 in USA, about 115 in UK and about 227 in Japan. The engineering education in India, however, suffers from limited reliable information resources being available due for want of a comprehensive management information system and inadequate participation in international surveys/evaluations that could provide a reliable comparison with engineering education globally. The average number of students in an engineering college in India works about to nearly 445 compared to about 7331 in China, 2213 in USA, 1275 in UK and 2128 in Japan. This means a greater chance that finances of Indian institutions will be stretched and they are more likely to face an investment crunch as regards equipment or quality improvement initiatives. That, to a certain extent, sums up the challenge of providing quality technical education in India. Even in terms of number of teaching faculty, while China has over 283000 engineering faculty and Russian Federation has over 107500 engineering faculty, the estimated numbers in India are close to 63000 giving an average of 19 faculty members/institution in India compared to 496 in China, 223 in Russian Federation, 187 in UK, 115 in Japan, 114 in USA and 62 in Brazil. Gandhi(2013) reports Indian educational system as being resistant to change, lacking in relevance and effectiveness and plagued by unplanned institutional proliferation as well as unabated increase in student enrollment making the higher education system in India unsatisfactory. Narayan (2005) points to the areas for improvement in the higher education in India as including: (a) Inadequate focus on quality in higher education resulting in mismatch between demand and output. Instead of a typical pyramidal structure in terms of skill levels with the bottom representing unskilled workforce, the structure of human resources in India is more like an hourglass with a large number of Professionals (engineers, doctors and lawyers) of indifferent quality who cannot be gainfully employed and a relatively insufficient number of semi-skilled workforce like electricians, plumbers and mechanics though these skills are much in demand; (b) The examination system is more focused on assessing memory and rote learning than problem solving skills, application of knowledge, analytical skills or ability to innovate; (c) Poor quality of teaching further aggravated by in-breeding wherein alumni are recruited and inadequate stress on student feedback; and (d) A large number of students going abroad for quality education especially in the area of technical education.

While the number of engineering colleges has grown rapidly, the institutions are often short on equipment or faculty development leading to relatively lower quality of education. There is abundant literature available on the macro view of higher education in India and the challenges it faces. However, there is a relative dearth of research at the institution level as regards technical education in India. This study aims to assess the quality of technical education imparted in the graduate course in engineering with specific reference to aspects of education that require action/correction at the institution level. It will add to the body of knowledge available on institution level study and provide a possible methodology to work towards improving education offered.

Literature Review

Dr.APJ Abdul Kalam, India's eleventh President from 2002 to 2007 said in 2002, “Higher education as a social aspiration, as an instrument or means of ignited minds was missing. For achieving the status of developed nation by 2020, there is no choice but to significantly increase the access with quality in higher education for generating the ignited minds.” The focus, was clearly, access and quality in higher education.

Gupta and Gupta (2012) trace the growth in number of institutions of higher education as shown in Table 1 below:

Table 1: Growth of Higher Education in India since independence in 1947

Year	Universities	Colleges
1947-48	20	496
1950-51	28	578
1960-61	45	1819
1970-71	93	3227
1980-81	123	4738
1990-91	184	5748
2000-01	266	11146
2004-05	348	17625
2005-06	355	18064
2006-07	367	19000
2007-08	416	20677
2008-09	480	22000
2009-10	504	25951

Source: Gupta and Gupta (2012) "Higher Education in India: Structure, Statistics and Challenges" citing UGC and Higher Education in India, Annual Reports
(Universities include central, state, private, deemed and also institution of national importance established both by the central and state legislatures).

The paper cites MHRD Annual Report of 2009-10 to give the break-up of 504 Universities in 2009-10 as including 243 state universities, 130 deemed universities, 53 state private universities, 40 central universities, 33 institutions of national importance and 05 institutions established by state legislative. Data presented by Suresha and Mylarappa (2012) for the period from 1983-84 to 2006-07 citing University Grants commission and Government of India 2007 (Selected Educational Statistics 2006-2007) shows that the big jump in student enrollment came in 2004-05. The 2013 Annual Status of Higher Education of states and UTs in India points to the increasing number of private institutions partly due to the fact that public expenditure in higher education hovered around 1% of India's GDP over the years, quite inadequate, at least partly, on account of the burgeoning requirements of this sector. This has provided an excellent opportunity to private sector institutions with the number of private HEIs growing from 18145 in 2007 to 29662in 2012 and the share of private HEIs in 2012 approaching 64% (29662 HEIs) with state government contributing about 35.6% (16547 HEIs) and central government contributing less than 0.5% (221 HEIs). In terms of student enrollment too, private HEIs account for about 59% enrollments (12823000), state government about 38.6% (8400000) and central government the remaining 2.6% enrollments (563,000). Cheney et.al.(2005) cite Public report of Basic education, 1999 to point out that though India has a large young population, on an average males in India complete only 2.9 years of schooling while females complete only 1.8 years of schooling making India a country with a very large number of poorly educated/skilled young people. The profile document discusses the fall in public expenditure for higher education from 1% of GNP in the 1970s to just 0.35% in mid 1990s, a percentage that grew to 0.6% by middle of the first decade of 21st century. Even till late 1980s, central government provided upto 90% of total funding for higher education with just about 5% coming from student fees. However government subsidies fell drastically in the 1990s for secondary and higher education with primary education getting higher share.

Historically, the Five Year Plans have contributed significantly to growth in education by focusing on various aspects of education. India's tenth five year plan (2002-07) emphasized universalization of Elementary Education based on universal access, universal enrollment, universal retention, universal achievement and equity. The results show in the improved gross enrollment ratio from 2001-02 to 2004-05 registering a percentage point increase in enrollment as given below:

1. Primary (I to V) showing a percentage point increase of 5.4% for boys and 17.8% for girls;
2. Upper Primary (VI to VIII) showing a percentage point increase of 6.5% for boys and 13.0% for girls;
3. Overall (I to VIII) enrollment saw a percentage point increase of 6.2 for boys and 16.3% for girls.

The targets for the eleventh five year plan (2007-12)

include:

1. Achieving 80% literacy rates;
2. Reducing gender gap in literacy to 10%;
3. Reducing regional, social and gender disparities; and
4. Extending coverage of NLM (National Literacy Mission) programmes to 35+ age group;

The special focus areas include special focus in SCs, STs, minorities and rural women besides focusing on low literacy states, tribal areas, other disadvantaged groups and adolescents.

The tenth five year programme also addressed quality improvement in schools through a composite Centrally sponsored scheme that was the outcome of converging five schemes, namely, (a) Improvement of Science Education in Schools, (b) Promotion of Yoga in Schools, (c)Environmental Orientation to School Education, (d) National Population Education Project, and (e) International Science Olympiads. The first was transferred to individual states while the remaining four were implemented by NCERT. At the college and university level, creation of NAAC in 1994 and subsequent NAAC accreditation provide a possible measure for focus on quality. The comparative data relating to 2002 and 2007 is given below:

1. The number of NAAC accredited Universities in 2002 was 61 (out of a total of 201). This became 140 (out of a total of 378) in 2007. This while the total Universities increased almost 80%, the NAAC accredited Universities increased almost 133%;
2. The number of NAAC accredited colleges in 2002 was 198 (out of a total of 12342). This became 3492 (out of a total of 18064). This while the total colleges increased a little less than 50%, the NAAC accredited colleges in 2007 was over 17 times the figure in 2002. Colleges have clearly taken to NAAC accreditation in a big way.

The increased focus on accreditation follows a similar trend seen in developed countries. Based on a survey with 225 responses from 41 states in USA, three Canadian provinces and Puerto Rico, WICHE Cooperative for Educational Technologies (2013) found that though a large fraction of institutions are adopting (accreditation) standards and best practices, institutions had trouble providing their course completion rates with about 2/3rd unable to provide on-campus completion rates and over half unable to provide on-line completion rates.

While accreditation does add to the reputation and credibility of an educational institution, it is not just accreditation that builds the reputation of higher education institutions. The Global Management Education Graduation Report (2012) based on 5366 soon-to-be management graduates (class of 2012) from 136 business schools presents a business school's reputation as including program standards, mission, talent level of fellow students, networking opportunities with classmates, and relevance of curriculum as the top five drivers of business school reputation.

The foreword of Ernst & Young LLP and FICCI's (2013) "Higher Education in India: Vision 2030" for FICCI Higher Education Summit 2013 says, " Despite many new national missions/programs and reforms agenda, by both the central and state governments with private sector intervention, the higher education sector is in a state of complete flux. While we have tremendously enhanced capacity, we lag in quality, given inadequate autonomy to our Universities. Centralized control and a standardized approach remain at the heart of regulations. We are in the 21st century with a mid-20th century regulatory architecture". Given below are some added indicators that point to a need for changes in higher education in India:

a. Despite the fact that India's higher education system in India is huge with about 45000 institutions catering to over 30 Million students, in terms of Gross Enrollment Ratio (GER) India lags behind developed countries like Japan, Switzerland, UK and US as well as developing countries like Brazil, China, Malaysia and Philippines.

b. The systemic problems in Indian higher education system include: (i) Disparity in higher education across genders, geographies and social groups; (ii) Low employability of graduates; and (iii) Well behind the developed world and even BRIC nations in terms of research output and university rankings. These problems show themselves through the following: (a) There were only 4 Indian institutes in the top 400 Universities in the world with none in the top 200; (b) About 35% of faculty positions in state universities and 40% in central universities are lying vacant with these two jointly accounting for over 50% of degrees awarded in 2011-12; (c) The student faculty ratio in higher education all over India fell from 14.2:1 to 27.8:1 from 1980-81 to 2011-12 partly because student intake increased without commensurate increase in faculty strength; and (iv) Only 10% of general graduates and 25% of engineering graduates are employable. Further, the vision document cites FICCI-World Bank employer satisfaction survey conducted across 150 companies in India to say that satisfaction level of about 64% of employers with the quality of engineering graduates' skills falls in one of the

categories, “not at all”, “not very”, or “somewhat” satisfied. The key skill gaps include specific skills like problem solving, analytical ability and reading besides general skills like motivation, willingness to learn and reliability.

Like the five year plans in India, setting ambitious targets on a macro level has been observed in Europe too. Starting with the Open Method of Education and Training (EC 2002), European Trade Union Confederation (2012) identified five benchmarks on education and training to be reached by 2010. These were: (i) Increasing the share of university graduates in mathematics, science and technology by, at least, 15%; (ii) To have 12.5% adults in the age group of 25 to 64 participate in lifelong learning; (iii) Reducing percentage of early school leavers to not more than 10%; (iv) Raising the percentage of young people in the age group of 20 to 24 years completing upper secondary education to, at least, 85%; and (v) Reducing low-achieving pupils in reading by, at least, 20%. Of these only the first objective was met while there was deterioration in the share of low-achieving pupils in reading.

The extent of learning imparted to students and its monitoring by governing bodies remains an area of concern even in the most developed countries. Survey by the Association of Governing Bodies (USA) (2010) found that close to 69% of the governing boards of educational institutions receive information about student learning outcomes as measured by standardized examinations and over 60% receive both trends and comparative data. However, over 61% respondents said not enough time is spent during board meetings on student learning outcomes and about 79% said that Board Meeting spent either a little more or much more time on financial issues including budgetary ones. Further, the usage of data on student learning outcomes and its linkage to budgetary decisions appeared weak leaving open the possibility that money was being invested in areas not necessarily benefiting student learning outcomes.

The Programme Assessment Handbook (2008) of University of Central Florida defines student learning outcomes as, “Student Learning Outcomes (SLOs) are specific statements that describe the required learning achievement that must be met on the way to attaining the degree and meeting the goals of the program.”Prasad, Director NAAC advocates the best practices in benchmarking approach for quality enhancement in higher education. The five step strategy for application of the best practices approach involves the following steps; (a) Identify the best practice; (b) Implement the best practice; (c) Institutionalize the best practice; (d) Internalize the best practice; and (e) Disseminate the best practice. Identifying best practices, however, requires listing parameters that have a bearing on education quality. Kulshreshtha et.al. (2013) list the following dimensions of education quality: (a) class room ambience; (b) institute facilities; (c) teaching quality; (d) faculty research; (e) student-faculty relationship; (f) course plan design; and (g) activity register design. The Economist's Intelligence Unit (2013) also highlighted challenges as regards higher education in South Asia as including: (a) need to address poor international rankings of universities by 'depoliticizing' the sector and strengthening standards as well as quality assurance mechanisms; (b) need to enhance employability of graduates by raising their skill level; (c) need to align courses offered by higher education institutions with needs of the market so as to reduce unemployment / underemployment among graduates.

Research Methodology

The study is a descriptive research using a positivistic approach of collecting (primary) data through the survey method using convenience sampling. Only final year students of four year B.Tech programme were surveyed for this research as they had been through most of the programme and were better placed to provide insights into it than any other group of students. Students approached for this survey were given the option of opting out if they felt uncomfortable giving their opinion on their programme or wanted to opt out for any other reason. Respondents were assured of confidentiality of their identity and that of their institution. A total of 41 student responses were accepted. A structured questionnaire using five point scale was developed based on standard tools used by reputed universities. The questionnaire was based on STUDENTS EVALUATION OF EDUCATION QUALITY (SEEQ) Standardized Instrument at the U of S and Academic Standards committee Handbook of Graduate Council at Southern Connecticut State University. The data collected was statistically analyzed for a level of significance (α) of 5% using a five point Likert scale.

The following hypotheses were tested in this research:

H_{01}: Majority of students are satisfied with the learning acquired in their degree programme;

H_{02}: Majority of students are satisfied with the enthusiasm and teaching of course instructors in the degree programme;

H_{03}: Majority of students are satisfied with the programme/course organization of their degree programme;

H_{04}: Majority of students are satisfied with the level of group interaction and exchange of ideas/knowledge;

H_{05}: Majority of students are satisfied with the breadth of knowledge imparted in their degree programme;

H_{06}: Majority of students are satisfied with the level of group

interaction during their degree programme;

H_{07}: Majority of students are satisfied with the examinations conducted during their degree programme;

H_{08}: Majority of students are satisfied with the assignments given during their degree programme;

H_{09}: Majority of students are satisfied with facilities provided for the degree programme;

H_{10}: Majority of students found the degree programme to be above average in the overall assessment.

Key Findings and Analysis of Data

Given below is the summary of findings from the survey carried out as percentage responses:

1. SUBGROUP SUMMARIES

	Not applicable	Disagree + Strongly Disagree	Neutral	Agree + Strongly Agree
LEARNING FROM DEGREE PROGRAMME	0%	12%	36%	51%
INSTRUCTOR ENTHUSIASM DURING DEGREE PROGRAMME	0%	30%	37%	33%
PROGRAMME AND COURSE ORGANIZATION	3%	24%	33%	40%
GROUP INTERACTION	1%	31%	32%	36%
INDIVIDUAL RAPPORT WITH STUDENTS	0%	16%	25%	59%
BREADTH OF DEGREE PROGRAMME	1%	23%	44%	32%
EXAMINATIONS	2%	26%	33%	39%
ASSIGNMENTS	1%	17%	29%	53%
UNIVERSITY & PROGRAMME FACILITIES	1%	29%	27%	45%

2. OVERALL ASSESSMENT

	Not applicable	Very Poor + Poor	Average	Good + Very good
Compared to other degree programmes I considered before joining, I would say this degree programme is	0%	13%	33%	56%
Compared to other degree programmes I have become aware of since joining, I would say this degree programme is	0%	13%	40%	48%
As an overall rating, I would say the degree programme is	0%	16%	32%	52%
SUBGROUP SUMMARY	**0%**	**14%**	**35%**	**51%**

Conclusions and Limitations of the Study

Given below are the p values in each case and the conclusions that follow for a level of significance of 5% ($\alpha = 0.05$).

Sl. No.	Hypothesis	p Value	Conclusion
H_{01}	Majority of students are satisfied with the learning acquired in their degree programme	Sample data not in rejection region	Hypothesis can't be rejected
H_{02}	Majority of students are satisfied with the enthusiasm and teaching of course instructors in the degree programme	0.017	Hypothesis rejected
H_{03}	Majority of students are satisfied with the programme/course organization of their degree programme	0.1	Hypothesis can't be rejected
H_{04}	Majority of students are satisfied with the level of group interaction and exchange of ideas/knowledge	0.03	Hypothesis rejected
H_{05}	Majority of students are satisfied with the breadth of knowledge imparted in their degree programme	Sample data not in rejection region	Hypothesis can't be rejected
H_{06}	Majority of students are satisfied with the level of group interaction during their degree programme	0.01	Hypothesis rejected
H_{07}	Majority of students are satisfied with the examinations conducted during their degree programme	0.07	Hypothesis can't be rejected
H_{08}	Majority of students are satisfied with the assignments given during their degree programme	Sample data not in rejection region	Hypothesis can't be rejected
H_{09}	Majority of students are satisfied with facilities provided for the degree programme	0.23	Hypothesis can't be rejected
H_{10}	Majority of students found the degree programme to be above average in the overall assessment	Sample data not in rejection region	Hypothesis can't be rejected

The conclusions above suggest that the concern areas as for as the four year degree programme is concerned are:

1. Instructor Enthusiasm during Degree Programme
2. Group Interaction and Exchange of Ideas/Knowledge
3. Breadth Of Degree Programme

These concern areas relate to a modest criterion of 'Majority of students' that when quantified translates to over 50%. If the criterion were more ambitious, say 75% students agreeing or strongly agreeing in their rating of the course features/characteristics, every one of the hypotheses would have been rejected highlighting the crisis in the four year technical (degree) course.

The study brings out a highly cost effective method of identifying areas of improvement for providing actionable inputs in a very short time. The data collected can be treated as a starting point for setting the agenda for improving the technical institutions offering four year degree programme. The institution needs to focus on the breadth of the programme, instructor enthusiasm during the degree programme and group interaction wherein students are encouraged to participate in the class and share their views/ideas.

The main limitations of the study relate to data being collected from only one institution making it relevant to that institution and no other institution offering a four year degree course in engineering. An institution specific initiative would be required to identify areas of improvement at each institution in question. A larger sample, if feasible, would surely reduce the possibility of error in the outcome. At an overall level, a cross-institutional study would enable identifying specific areas of improvement based on customer (student) feedback on the programme. Finally, benchmarking was not carried out since comparative data does provide useful pointers to required improvements and benchmarking was not carried out as part of this study. Technical education needs urgent uplifting if engineering graduates and industry are to remain competitive.

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