R. Natarajan *Editor*

Proceedings of the International Conference on Transformations in Engineering Education

ICTIEE 2014

Springer

Proceedings of the International Conference on Transformations in Engineering Education

R. Natarajan
Editor

Proceedings of the International Conference on Transformations in Engineering Education

ICTIEE 2014

Springer

Editor
R. Natarajan
Chairman, Board for IT Education
Standards (BITES)
Bangalore, Karnataka, India

ISBN 978-81-322-1930-9 ISBN 978-81-322-1931-6 (eBook)
DOI 10.1007/978-81-322-1931-6
Springer New Delhi Heidelberg New York Dordrecht London

Library of Congress Control Number: 2014950665

Printed on acid-free paper

Springer is part of Springer Science+Business Media (www.springer.com)

Preface

The International Conference on Transformations in Engineering Education (ICTIEE) was organized by the B V Bhoomaraddi College of Engineering, Hubli, India, during January 16–18, 2014. This volume includes the plenary, keynote, and contributed papers presented during the conference. The contributed papers were subjected to a detailed evaluation procedure involving a number of competent reviewers.

Currently, we are witnessing a range of transformations in engineering education both internationally and nationally. Older paradigms and practices are being rendered obsolete, and new ideas are emerging. Some of the new buzzwords surrounding engineering education include MOOCs, global engineers, outcome-based teaching and learning, good governance, academic leadership, technology-assisted learning, and research-intensive institutions.

International partnerships, networking of institutions, harmonization of quality assurance, and accreditation systems and processes are becoming the concern of institutions across the world. There is intense activity worldwide in disseminating and sharing knowledge and experience of different countries and institutions.

ICTIEE 2014 was truly international in character. There were several international speakers and foreign exhibitors of education-related products and services in addition to their Indian counterparts. A large number of students participated in the conference. The international student organization SPEED (Student Platform for Engineering Education Development) organized several activities during the conference. It was very heartening to see the active participation of the delegates in the different sessions and their networking with the speakers and the other delegates.

We are thankful to the faculty members of BVB College of Engineering, who willingly undertook a variety of responsibilities, and also to the reviewers who completed their tasks on time.

It is hoped that this proceeding volume will be very useful and of lasting value to academic leaders, faculty members, professionals, and engineering students.

Dr Krishna Vedula and Dr Ashok S. Shettar served as coeditors for this volume. I am very grateful for their support in this endeavor.

Bangalore, Karnataka, India R. Natarajan

ICTIEE 2014 Committee

Chief Patron

Prabhakar Kore

Advisors

Dr. Jose Carlos Quadrado, President, IFEES,
President, Instituto Superior de Engenharia de Lisboa (ISEL), Portugal.
Dr. R. Natarajan, Chairman, Board of IT Education Standards (BITES), India,
Former Director IIT Madras, India.
Dr. Hans J. Hoyer, Secy General, IFEES,
Executive Secretary, GEDC, Marquette University, USA.
Dr. Gururaj 'Desh' Deshpande, Trustee, Deshpande Foundation,
Life Member, MIT,
Sparta Group, Sycamore Networks, Tejas Networks, USA.
Mr. Arjun Malhotra, Chairman and CEO,
Headstrong Corporation.
Mr. H. U. Talawar, DTE,
Bangalore.

Conference Chairs

Dr. Ashok Shettar, Principal, BVB College of Engineering & Technology, Hubli – 580031 (India)
Dr. Krishna Vedula, Professor, Dean Emeritus, Umass Lowell, USA., Executive Director, IUCEE

Program Chairs

Dr. M. P. Ravindra, President, IUCEE India Society, Bangalore, India.
Dr. Bopaya Bidanda, Professor, University of Pittsburgh, USA.
Dr. Anil Sahasrabuddhe, Director, College of Engineering, Pune (India)
Dr. Ashok Kalbag, Secretary, IUCEE India Society, Mumbai, India.
Dr. Gopalkrishna Joshi, Director, CEER, BVB College of Engineering & Technology, Hubli – 580031 (India)

Publication Chair

Dr. R. Natarajan, Chairman, Board of IT Education Standards (BITES), India, Former Director IIT Madras, India.

Program Committee

Dr. Vinod K Lohani, Professor, Virginia Tech University, USA.
Prof. B. L. Desai, Vice Principal, BVB College of Engineering & Technology, Hubli – 580031 (India)
Dr. P. G. Tewari, Professor & Head, Mechanical Engineering, Dean (Academic Affairs), BVB College of Engineering & Technology, Hubli – 580031 (India)
Dr. N. H. Ayachit, Professor, Rani Chennamma University, Belgaum
Dr. Linganagouda Kulkarni, Professor CSE, PG Coordinator, BVB College of Engineering & Technology, Hubli – 580031 (India)
Prof. S. C. Padashetty, SPFU, Bangalore
Dr. A. K. Kulkarni, SPFU, Bangalore

Contents

Part II Presented Papers

Part III Presented Posters

About the Editors

Editor

R. Natarajan received his M.E. degree from the Indian Institute of Science, Bangalore, and his M.A.Sc. and Ph.D. degrees from the University of Waterloo, Canada. He has worked as a National Research Council Fellow in Canada, and as a Humboldt Research Fellow in Germany.

He served as Director of the Indian Institute of Technology, Madras, from 1995 to 2001, and as the Chairman of the All India Council for Technical Education, a statutory body of the Government of India, from 2001 to 2004. He was the Vice President of The Indian National Academy of Engineering during 2002–2006, and the Chairman of the Research Council of the Central Fuel Research Institute, Dhanbad, during 1995–2005. He is currently the Chairman of the Board for IT Education Standards of Karnataka. He is a Fellow of Indian National Academy of Engineering, Indian Society for Technical Education, National Academy of Social Sciences, and Institution of Engineers (India). He has been conferred Honorary Doctorate Degrees by University of South Australia, Jawaharlal Nehru Technological University, Kanpur University, Nagarjuna University, Purvanchal University (U.P.) and NIT, Agartala.

He has been a Member of the Editorial Boards of many prestigious journals including *Fuel*, *Fuel Science and Technology*, and *Indian Journal of Technical Education*. He is currently on the Editorial Board of the *Journal of Engineering Education*, published by the American Society for Engineering Education (ASEE).

Associate Editors

Krishna Vedula is Professor of Chemical Engineering and Dean Emeritus, Francis College of Engineering, University of Massachusetts, Lowell. Dr. Vedula is currently Founder and Executive Director of the Indo-US Collaboration for Engineering Education (IUCEE) facilitated initially by ASEE. IUCEE has the objective of improving quality and global relevance of engineering education in India and US. For the past five years, IUCEE has facilitated interactions between several hundreds of US faculty and several thousands of Indian faculty. He has also been the President of International Federation of Engineering Education Societies (IFEES) from 2010 to 2012.

Dr. Vedula is well recognized globally for his contributions to engineering education, research, administration, and outreach. He is internationally recognized for his research in processing and properties of materials for high-temperature applications, with particular emphasis on powder processing and inter-metallic compounds. He has been made a Fellow of American Society for Metals (ASM) and a Fellow of the American Society for Engineering Education (ASEE) in recognition of these professional achievements.

As dean of engineering at University of Massachusetts (1995–2003), he has demonstrated his leadership in building unique partnerships with businesses, K-12, state agencies, and other educational institutions. He was responsible for raising several millions of dollars for scholarships, endowments and facilities from private sources and for overseeing a significant improvement in the quality of students and faculty as well research and teaching facilities at the Francis College of Engineering. He is Founder of "Massachusetts STEM (Science Technology Engineering and Mathematics) Collaborative" aimed at increasing the number of students in the state interested in pursuing science and engineering. This has now evolved into a program of the State of Massachusetts.

Dr. Vedula has B.Tech. (IIT Bombay, 1967), M.S. (Drexel University, 1969) and Ph.D. (Michigan Tech University, 1980) degrees in Materials Engineering. He has 30 years of academic teaching and research experience in materials science and engineering as well as engineering administration, including 10 years as a faculty member at Case Western Reserve University, 5 years as chair of the materials science and engineering department at Iowa State University, and 8 years as dean of an engineering college at UMass Lowell. In addition he has spent 2 years managing federal research and educational programs.

Ashok S. Shettar earned his Ph.D. from the Indian Institute of Science, Bangalore (India). He has three decades of experience in Engineering Education. His conviction and systemic practice of Outcome-Based Education (OBE) have taken his Institution to greater heights in India. He has the experience of acting as resource person in workshops on outcome-based education in local, regional and national levels in India. He is an active researcher in Engineering Education. Dr. Ashok Shettar is currently the Principal of BVB College of Engineering and Technology, Hubli, India.

Part I
Invited Papers

Transformations in Engineering Education Globally

Stephanie Farrell, Hans J. Hoyer, and Duncan McKenzie Fraser

All of us are aware of the critical but exciting evolution of research universities from the 1960s until today, a metamorphosis in which universities have gone from insular "ivory towers" to key drivers of economic prosperity. This has resulted in dramatically expanded missions for engineering colleges and the program of engineering education. Leading global experts have described the global drivers of those expanding missions in terms of accessible and inexpensive global communications, global partnerships, globalization, expanding access to higher education, expanding opportunities for talent, cost control, innovation, global "grand" challenges, and leadership challenges. Recent global discussions related to the transformation of engineering education have emphasized that excellent pedagogy in engineering education can benefit greatly from the appropriate use of today's rapidly developing information and communication technology. A wide variety of approaches to the use of ICT greatly improve learning experiences by providing more personalized and effective learning environments for students. In addition, approaches such as MOOCS are rapidly making educational opportunities available to people who otherwise would not have access to college courses. Not only are MOOCS making high-quality educational courses available to an unprecedented number of students, these courses also provide a plethora of student data that helps advance learning science and provides guidance and feedback which can be used to improve student education. The widespread use of ICT in engineering

S. Farrell (✉)
Department of Chemical Engineering, Rowan University, Glassboro, NJ, USA
e-mail: Farrell@rowan.edu

H.J. Hoyer
College of Engineering, Marquette University, Milwaukee, WI, USA
e-mail: h.hoyer.ifees@gedc.info

D.M. Fraser
Department of Chemical Engineering, University of Cape Town, Cape Town, South Africa
e-mail: duncan.fraser@uct.ac.za

R. Natarajan (ed.), *Proceedings of the International Conference on Transformations in Engineering Education: ICTIEE 2014*, DOI 10.1007/978-81-322-1931-6_1,

education is in its early stages. It seems clear from the global ongoing discussions during the last couple of years that this field will continue to develop rapidly and has the potential to transform global engineering education in the relatively near future.

Strongly influenced by the US National Academy of Engineering (NAE), the moderator of the panel focused on numerous critical strategic issues confronted by the global engineering education community. These issues focused on the reality that the combination of global connectivity and accelerating change will increasingly create abrupt disruptions and that universities and colleges will need to fundamentally change their mindset to be able to respond to those changes. The fact that too many colleges are behind in the use of new technologies in their overall culture is deeply disturbing and presents a real challenge. Partnerships globally will be embedded in the engineering culture and will characterize engineering operations for many if not most of it functions. Students must be prepared to effectively engage in the global community. “Working around the world” for them will be similar to “working around the country” which has been the paradigm in the past. It has become increasingly clear that the engineer’s reality is global. Engineering colleges should nurture global talent in leadership, management, and “current skills” for professionals across disciplines through targeted degree and certificate programs. They are poised to create university-wide cultures of innovation that would extend beyond their campuses to surrounding communities and beyond. They will engage multidisciplinary teams, usually led by engineering, focusing on great global challenges such as environmental degradation, climate change, and other universal issues. Shaping the university and college cultures so that they can contribute and prosper under these world drivers is the most important and interesting responsibility of university and college leadership today and engineering will play a central role in all of these strategic challenges.

1 Panel Discussion: Transformations in Engineering Education Globally

Stephanie Farrel
Department of Chemical Engineering, Rowan University, Glassboro, NJ, USA

The Corporate Member Council of the American Society for Engineering Education together with IFEES recently surveyed engineering stakeholders around the world to develop a series of competencies and characteristics necessary for a modern engineer to work in a global environment. This study and others send a clear message that we must improve the focus on fundamentals, teach more real-world thinking, increase coverage of emerging areas, teach problem-solving skills, offer more instruction on oral and written communications, instill in students an awareness of ethical, environmental, and social issues, and so on. These findings have significant overlap with those of that National Academy of Engineers [1] and National Science Foundation [2] as well as the outcomes sought by accrediting bodies such as ABET, IChemE, and Engineers Australia. In addition, we must not increase the total number of credits or time required to complete a degree. It is clear that these goals are not achieved by traditional engineering education and that a major transformation is necessary to create an engineering ecosystem that supports the development of global competencies. What is the role of teaching, course, and curriculum reform in this transformation?

In recent years, research on instructional practice and learning in engineering has led to a variety of teaching strategies that effectively enhance learning outcomes. These strategies are accessible to educators through a variety of mechanisms such as journals and conferences, workshops, webinars, and certification programs such as IGIP's ING-PAED International Engineering Educator certification. Yet most instructors continue to rely on traditional and ineffective teaching methods in the classroom. Similarly, some engineering programs have successfully reformed courses and curricula to improve learning outcomes, but faculty members are often hesitant to engage in such efforts.

Over a decade ago, Felder et al. [3] explained that the gap between the current state of knowledge and practice results from the perception and reality that good teaching is not valued in terms of career advancement. The authors made a compelling case for the need to create a positive campus climate for good teaching. Fourteen years later, we are making very gradual progress toward this goal. This panel will explore the following questions? What can be done to accelerate this progress? How can forward-thinking administrators create incentives for faculty and departments to engage in assessment and reform of their programs? How can a positive culture for excellent teaching and educational scholarship be established on campuses?

2 Panel Discussion: Transformations in Engineering Education Globally – Focus on Africa

Duncan McKenzie Fraser
Department of Chemical Engineering, University of Cape Town, Cape Town, South Africa
duncan.fraser@uct.ac.za

I will confine my discussion to the parts of Africa that I am familiar with, which means that I will focus on sub-Saharan Africa. As engineering education in Africa can only be understood within the general education context, I will deal with that first.

All levels of education in sub-Saharan Africa have undergone significant transformations since most nations in this region gained independence from the colonial powers in the 1960s. In the 1970s there was a push for universal primary education, which pulled resources away from higher education. Apart from the changes postindependence, further transformation of the education sector was forced by the structural adjustment programs of the 1980s promoted by the World Bank and the International Monetary Fund, with a further reduction of state funding. In the 1990s this led in many countries to the introduction of fees for tertiary students, which caused some unrest.

Pre-independence, most sub-Saharan countries had only one or two universities, with many of them on expansive campuses which included both student and staff housing, the exceptions being Nigeria and South Africa. There has been an increase in the number of tertiary institutions since then, and more recently quite a significant private university sector has arisen in some countries.

South Africa had a very different education trajectory, achieving independence in 1910. While its education system was always skewed along racial lines, this became entrenched under the apartheid regime in power from 1949 onwards. This regime even introduced ethnic universities for black students. A well-resourced and good quality education system for whites was in stark contrast to an under-resourced and poor quality education system for blacks. This started changing prior to the first democratic elections in 1994, and since then there has been a strong push to equalizing resources and quality right across the system.

The engineering education sector in sub-Saharan Africa has felt the poor resourcing of higher education particularly strongly. Laboratories were often provided by donor funding, but upkeep was a problem and most gradually fell into disrepair. Libraries have been mostly very inadequate, especially in the light of most students not having access to textbooks. There are almost no resources for doing research. Academic staff have been badly paid, to the point that many have had to have a second income to survive, which usually detracted from fulfilling their teaching responsibilities properly. In Nigeria around the turn of the century, the government unilaterally doubled the intake into all engineering schools, without any increase in resources, which led to a decline in standards.

Most teaching in engineering education is by chalk and talk, with no significant student engagement, even though some lecturers are keenly aware of the education issues and trends elsewhere, having largely obtained their PhDs overseas. The opening up of the Internet does provide some hope for significant changes in the future, although this is severely limited at present by the very low bandwidth in most countries.

Engineering education in South Africa is a notable exception to all the characteristics noted above, with good resources and facilities, although the approach to teaching and learning in many places is still very lecturer-focused. Note that black students were only able to study engineering in South Africa from the early 1980s onwards. In my institution there is one very significant transformation of undergraduate engineering education, based on the latest research into teaching and learning.

References

1. Vest C. Educating engineers for 2020 and beyond. Reform Eng Educ. 2006;36(2):38–44.
2. Transforming undergraduate education in engineering, Phase I: synthesizing and integrating industry perspectives; 2013 May 9–10; Workshop Report, National Science Foundation, 2013
3. Felder R, Stice J, Rugarcia A. The future of engineering education: making reform happen. Chem Eng Educ. 2000;34(3):208.

The Important Tool for the Transformation in Global Engineering Education: Mobility

Hasan Mandal

Keywords Global engineers • Mobility • Quality assurance

While global challenges (such as changes in demographic structure, demands for better living conditions, sustainability, climate change, and other changes in nutrition, water sources, health, energy, environment) are becoming a part of our daily life, the importance and the necessity of the graduates who have global attributes are becoming more and more important. Since most of these global challenges are much more related to the engineering issues, engineering education with a global perspective is needed. The competences to achieve global engineering attributes can not only be obtained from one engineering college. Many engineering schools are requesting at least a term for study abroad. In year 2020, 7 million of the students will be mobile globally, and the aim for the European Commission is that 20 % of graduates will take at least study abroad. There are many types of mobility which are as follows:

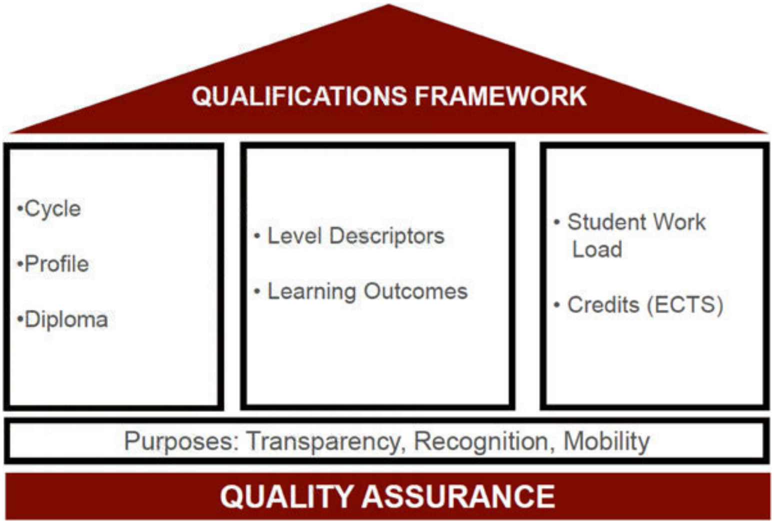
- Migratory Mobility
- Vertical (Intercycle) Mobility
- Individual Mobility for Study Period Abroad
- Short Organized Group Mobility (summer schools)
- Erasmus-Type (Exchange) Mobility (international and national levels)
- Integrated Mobility (double/joint degree)

One of the important obstacles for the mobility is the recognition of the courses which are taken from the other institutes. Although most of the engineering colleges are applying similar curriculum, many students are having a problem to transfer their knowledge and skills.

H. Mandal (✉)
Vice President (Research and International Relations), Sabanci University, Istanbul, Turkey
e-mail: hmandal@sabanciuniv.edu

R. Natarajan (ed.), *Proceedings of the International Conference on Transformations in Engineering Education: ICTIEE 2014*, DOI 10.1007/978-81-322-1931-6_2,

European approach is to improve transparency, recognition, and therefore the mobility in higher education systems by using the tools of Bologna Process. Bologna Process is simplified by the following figure.



As can be seen from this figure, Qualifications Frameworks (QF) and Quality Assurance (QA) are the main pillars. The others (cycles, profiles, diplomas, level descriptors, learning outcomes, student workload, and credits) are just the tools. Therefore, the understanding QF and QA are rather important.

In this respect, the accreditation experience of engineering programs either by WA or EUR-ACE systems is giving a great advance for the transparency and the recognition and therefore the mobility of the learners in all levels.

Adopting MOOCs for Quality Engineering Education in India

Deepak B. Phatak

Abstract In India, over 5,000 engineering colleges affiliated to different universities offer conventional engineering education. Teachers in colleges do the teaching, but universities rigidly control the programme of study, syllabus, and examinations. The quality of education is a matter of concern. MOOCs (Massive Open Online Courses) permit learners to access and benefit from the teaching by renowned professors. MOOCs offer an unprecedented opportunity to revitalise education. These cause complete disintermediation of the university system, making them very affordable; however, they have several shortcomings in their present form. Students enrolling for a MOOC still have to conventionally study the subject for their degree. Complete absence of physical group activities in a classroom under a teacher's mentoring is another serious issue. Conduct of practical sessions in laboratories is an important aspect of engineering education, for which MOOCs offer no alternative.

We propose a blended MOOC model for adoption in India. It envisages acceptance of MOOC grades by a university towards its degrees. It also stipulates an important role for local teachers, who will use a 'flipped classroom' model of teaching. They will conduct group discussions and problem-solving sessions rather than mere lecturing and locally give and evaluate assignments of which the marks will be factored in the final grade. They will also conduct laboratories where needed. They will thus mentor and guide students, under their charge.

Keywords MOOCs • Blended education • Flipped classroom • Group activity • Teacher centric • Laboratories

---

This invited paper is based on an earlier keynote, delivered at Educon organised by 'Sakal group', at Istanbul in September 2013, and its subsequent versions delivered on several other occasions.

D.B. Phatak (✉)
Department of CSE, IIT Bombay, Kanwal Rekhi Building, Mumbai, 400076, India
e-mail: dbp@it.iitb.ac.in

R. Natarajan (ed.), *Proceedings of the International Conference on Transformations in Engineering Education: ICTIEE 2014*, DOI 10.1007/978-81-322-1931-6_3,

1 Growth of Engineering Education in India

India has about 5,000 engineering colleges today, a 25 times increase from just about 200 colleges 30 years ago. Annual enrolment of students in these colleges is now over 1,250,000. The number of qualified and experienced teachers is highly inadequate. As India moves to increase the GER (Gross Enrolment Ratio) in coming years, the need for quality teachers will increase, and the supply-demand gap will widen.

The quality of engineering education in Indian colleges suffers primarily because of the rigidity of our university system. A number of engineering colleges are affiliated to a university. While teaching takes place in individual colleges, it is the university which controls the syllabus and also the examinations. Teachers are required to teach strictly as per the prescribed syllabus which changes at a snail's pace, if at all. There is a fixed plan for the examinations. The papers include standard options such as 'Answer any 6 out of 10 questions'. The questions themselves are mostly descriptive, such as 'explain something', or 'describe something briefly', or 'write short notes on any two of the following', etc. Such papers are rather sweetly called 'theory' papers. Problem-solving abilities, central to engineering education, do not get adequately tested at all. As an added attraction, the questions are often repeated across examinations conducted in different years. A teacher, who teaches, has no control or even a say in these matters. Someone else is going to set the question paper, and some other one is going to evaluate the answer books. It is not uncommon to find that students routinely bunk classes and attend coaching classes or read guidebooks, which provide specialised training in passing such 'standard' examinations.

I myself studied in a similar college in the city of Indore. It was and is a good college, known for its quality faculty and students, but with a similar make-up. My own experience was that I studied 100 % syllabus in the first year. Having discovered the 'choice' in all examinations, I studied only 60 % syllabus in the second year, still securing more than 80 % marks. In the third year, I enhanced my skills to predict with reasonable accuracy, as to which questions were likely to be 'repeated' from the papers of previous years, in the next examination. I could further optimise on study time. Smarter students resorted to guidebooks and coaching classes, with more optimal outcomes.

For me, things changed drastically when I joined IIT Bombay for my MTech in 1969. My first brush with the IIT style examination was Prof. Jimmy Isaac's 'open-book' test. Time specified was 2 pm 'onwards'! Delighted, I carried six books to the exam. I was shocked to see no descriptive questions and no choice at all. There was simply a set of problems to be solved. Jimmy's style of conducting the examination was also very funny. He kept walking around the class, reading the solutions being worked out by students, occasionally slapping a student on the back, shouting 'not this way idiot, read that chapter from that book, and solve again'. I recall receiving two slaps. I returned the answer book at 6 pm. I was not the last student out, as there was one more joker still struggling. I was completely frustrated, but upon reflection later, I realised that I learned more in those 4 h than I did in a semester back home in my college.

A teacher in the IIT system has absolute control of the subject he or she teaches. Why is it that one Jimmy Isaac succeeds in motivating us to learn better, whereas like-minded teachers elsewhere are not able to do so as effectively? Why is it that the university system has not changed significantly, whereas the IIT system has thrived on continuous experimentation with the process of teaching, learning, and testing?

A large number of very good engineers come out of our engineering colleges. There are several excellent teachers in many colleges. Yet, the IITs somehow manage to produce better trained engineers. While it is true that funding available to most engineering colleges is meagre as compared to IITs, I believe that the true differentiator is the immense autonomy and its responsible and creative use, which one teacher enjoys and the other does not.

2 Role of a Teacher

To learn, to gather knowledge, and to use that knowledge for making life more comfortable, prosperous, and enjoyable are now integral parts of human endeavours. The society recognised very early that the vast amount of knowledge, gathered and accumulated over generations, must be passed to the next generation, for it to be substantially assimilated at an early age by the young humans. It is this urge to educate the young of the species quickly, which prompted humanity to create the institution of a 'teacher', charged with the responsibility of codifying, storing, disseminating, and enhancing knowledge. No other species (barring perhaps the bird Jonathan Livingston Seagull described by Richard Bach!) has created such an institution. In order to support this institution of a teacher, structures were created, which were known in India as ashram or gurukul in old times. Temples, mosques, and churches often served as places for teachers and disciples to congregate. A teacher in those days had the same stature as that of a parent. In fact, the ancient Indian tradition required a student to leave the safe abode of parents at the age of 6 or 8 years and live at the teacher's home for the next 12 years to learn from the guru. Apart from disseminating knowledge, the teacher was also responsible to inculcate values and discipline in the minds of the young. Under the mentorship of a teacher, a student would mature from a young learner into an informed and wise adult, ready to live in, and contribute to, a healthy, prosperous, and happy society.

Over the centuries, these support structures got formalised into schools, colleges, and universities. Curiously, these are now called institutions, and the original 'institution' of the teacher has now assumed the status of a paid employee of these institutions. The stature of a teacher, with the attendant autonomy, is still maintained in some places, such as most of the well-known universities, including our IIT system, and in some renowned colleges. However, in the affiliated colleges and their universities in India, the education process, particularly the engineering education, is governed by hierarchy, procedures, rules, committees, rigid syllabi, a set pattern