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Disjuncture between Engineering Education and the Industry

K. Pramila[1] and T. Muthukrishnan[2]

[1]Department of English, PSG Institute of Technology and Applied Research, Coimbatore 641 062, Neelambur, Tamil Nadu, India
[2]Department of Linguistics, Bharathiar University, Coimbatore 641 046, Tamil Nadu, India
E-mail: [1]<pramila@psgitech.ac.in>, [2]<tmkmadurai@gmail.com>

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ABSTRACT Engineering education in India is continually evolving, with curriculum developers, and governing bodies of higher education making changes to meet the global challenges in terms of employment and research. Yet, these changes have not been very successful, mainly because the way we measure and assess students' achievements remain the same. Moreover, soft skills related to academic matters and soft skills related to personal and professional development of the young students find no place in the curriculum. This paper aims at presenting the reasons for the gap between the academia and the industry, based on research and observation carried out in engineering colleges in Tamil Nadu and interactions with the industry. This paper is an attempt to discuss how some major changes in the teaching learning process could eliminate some hurdles that fresh engineering students face not only in getting employment but also in succeeding in their professional and personal lives.

INTRODUCTION

This study has been undertaken with intent to explore the missing link between the industry and the academia and the reasons for the great divide. It also focuses on the anomalies in engineering education, which is one of the main reasons for the unemployability of novice engineers. Even in ancient times, great philosophers have expressed strong views on education. Plato and Socrates believed that the aim of education is to obtain knowledge, while Aristotle differed. Aristotle believed in the purposefulness of education and the wholesome development of education with special emphasis on practical training and wisdom. Many terms are used for being industry ready but the skills required to be industry ready seems to be the same. Emphasis is on the non-technical skills, soft skills and practical application of knowledge that is the prerequisite for getting employed (Cranmer 2006). According to the psychologist Daniel Goleman (2010), soft skills contribute to a person's ability to manage him or herself and relate to other people – skills, which matter twice as much as IQ, or technical skills in job success. Many leading newspapers have reported on the unemployability of engineering graduates. The Times of India (2014) published an article highlighting the fact that only, "18.33 percent of engineers are employable." The situation remains more or less the same even after four years. Tech Mahindra CEO Gurnani (2018) in an interview to Times of India on 5th June 2018 has said, "Ninety-four percent of the Indian IT graduates are not eligible for jobs in the IT sector." A research conducted by Harvard University, the Carnegie Foundation and Stanford Research Center (2016) has extrapolated that, "Eighty-five percent of job success comes from having well-developed soft and people's skills, and only fifteen percent of job success comes from technical skills." This eighty-five percent enables young engineering graduates not only to be employable but also to experience career success. Yet, in engineering colleges in India, educators do not stress on the importance of teaching soft skills. The onus lies on educational institutions accepting and implementing soft skills in the curriculum. All the stakeholders including parents and students must understand that only a holistic and all round development will pave the way for the success of the young graduates.

The Harvard Research owes its origin to "A Study of Engineering Education" by Mann (1918) After 100 years, the big question still is: Are the colleges fostering learner and workforce needs? Research and surveys show that colleges are not focusing sufficiently on imparting communication skills and soft skills. Communication skills and soft skills are complementary and it is widely believed that schools and col-

leges should be doing better in preparing the learners for the workforce. Non-technical skills play an important role for a graduate in getting employed and doing well in the workplace (DEST 2006). Non-technical skills refer to, "generic capabilities, transferable skills, basic skill, essential skills, work skills, soft skill, core skills, core competencies and enabling skills or even key skills" (DEST 2006; Knight and Yorke 2006).

The field of education in India is under pressure as never before because the aim of education today is, not just to teach students the subjects prescribed in the curriculum, but the main aim seems to train the students to enter the workforce. The focus of this study is to emphasise the fact that; in order to prepare the students to be industry ready, educators should aim at providing experiential, constructivist education, personality development programmes, and new methods of assessment and create and reinvent effective approaches to teaching. The challenge lies in implementing all this and incorporating them in the regular curriculum with a heterogeneous student population.

In India, especially in Tamil Nadu, the mushrooming of engineering colleges, autonomous engineering colleges and private universities offering engineering courses churning out lakhs of unemployable engineers every year is a major cause for concern. The meteoric rise in the number of engineering graduates and the lack of employability skills has widened the gap between the industry and the academia. Hence, it is the right time for re-engineering engineering education. Lacunas exist between what the industry requires and the talent graduates possess, and it is very disheartening that the gap seems to get wider. Students lack even the skills that are perceived as essential, both at the workforce and for the student's own personal development. Research and surveys indicate that schools and colleges do not foster these skills among the young learners. If students could hone some attributes and acquire good communication skills and soft skills, they would fulfil the employers' requirements and hence, become employable.

Objectives

This study aims to highlight the huge gap between the academia and the industry, address the reasons for the gap and provide a few suggestions to bridge this great divide. This study stresses on the importance of infusing soft skills to engineering students to make them industry ready. This is a wakeup call for the curriculum developers and administrators to take imparting of soft skills more seriously and to focus more on teaching competencies and holistic approach rather than just coaching engineering students to pass in the examinations. Educators must find ways of incorporating skills in the curriculum employers look for in the young graduates to reduce the rate of unemployment among fresh engineering graduates.

METHODOLOGY

This paper is part of an ongoing research and the study is based on actual teaching experience of the researchers in engineering colleges, administering employability skills tests, and by eliciting and analyzing data through questionnaires and surveys and by formal and informal interactions with students. Questionnaires, mock interviews and case studies were formal modes of eliciting data, while informal interactions helped in understanding the actual problems faced by students in terms of communication and soft skills.

Questionnaires were administered to engineering students in the academic year 2017-2018 to final and pre final year students. The assessments were based on self-assessment models where students had to rate their own skills and ability. Some of the questions asked were on teamwork, leadership qualities, flexibility and adaptability, problem-solving skills, creativity, interpersonal skills, conflict resolution, work ethics, time management, decision making, handling feedback, motivation and enthusiasm, work ethics and so on. As the informants from the industry preferred anonymity, their feedback and opinions have been used to understand what the employers' find lacking in the young recruits. Some of the questions posed to the employers were: How does your organization define soft skills? What are the soft skills you look for in the young graduates? What are the most important soft skills students' lack? What are the soft skills that most often require improvement? How do you decide a student is work ready? Responses received from employers through telephonic and personal interviews and also personally being part of mock interviews along with the

people from the industry has provided rich data and background for this study. As mentioned earlier, this study is based on an ongoing research; the data for this study was collected from third and final year engineering students.

OBSERVATIONS AND DISCUSSION

This initial study has revealed that schools and engineering institutions must address the gap between what the employers expect from the fresh graduates and the employability skills that young graduates possess to ensure a smooth transition from student to employee. This study is to create more awareness among educators, students and all the stakeholders involved to improve the students' employability skills.

From the interaction with the students and the HRs (Human Resource) from the industry, it is clear that the students are still not meeting the expectations by the employers. Jobs are available in plenty but the employers are in constant search for the right person for the right job. An overwhelming number of young graduates are just not work ready. The reasons for the great divide are discussed below.

In India, the institutions, parents and students focus more on grades; hence, the institutions emphasize more on coaching to prepare the students for the university examinations, so that they would get good grades. Employers do not judge the employability of a prospective employee based entirely on their grades, because knowledge is easy to learn and measure, but not skills. Knowledge can be easily taught and learnt, whereas, skills take time and effort to facilitate and acquire. Employers need to invest time and resources to train young graduates in soft skills, which most corporate are not willing to do and consider such employees as a liability. In an interview to India Today (2016), Siddarth Bharwani, Vice President, JetkingInfotrain Limited, says, "The state of economy also plays a major role for employment generation. Industry insiders say that in a strained economic condition, companies do not want to spend much on training and would prefer candidates with some skill sets so that they can be made billable soon."

An employability and evaluation and certification company, Aspiring Minds (2016), released the National Employability Report, 2015-2016. According to the report, Tamil Nadu ranked at the bottom in employability. Its Chief Technology Officer, Varun Aggarwal said, "Poor unemployability has been a constant trend over five years and the report says eighty percent of the country's engineers are unemployable."

The state of engineering education is best-described by E. Balagurusamy, in an interview to Frontline (2015) "The quality of engineering education in Tamil Nadu is very bad. In the past ten years it has reached rock bottom."

Teaching, is the soul of the education system, if the soul is missing then it has a domino effect. The lack of competent teachers in many self-financing engineering colleges, autonomous engineering colleges and deemed universities has greatly affected the transfer of knowledge to the students. It is not the infrastructure or the building, but it is the faculty that make the difference. The quality of teaching is deplorable and low pay results in frequent teacher movement. Type 1 Faculty: "Student yesterday, professor today," has become the order of the day. Fresh postgraduates are recruited, as the institution does not have to pay much. They are given the huge responsibility of training next generation of engineers. It is not uncommon to see that after completing post-graduation, they join their alma mater as faculty. Such faculty lack teaching experience, soft skills and they do not possess expertise in the subject they teach, having graduated from a similar set-up.

The cream of engineers are placed in high paying engineering jobs, some in smaller engineering industries, some end up doing business on their own or take over the family business, while those still left take up teaching as the last option. Type II Faculty: Many young engineering graduates, who have not been selected by multinational and even smaller companies, join as faculty in engineering institutions. Therefore, they do not have the skills to create brilliant students. It is a known fact that when undergraduate students are asked if they are interested in pursuing teaching as a career the answer is a unanimous and emphatic, "No." Teaching was considered a suitable profession for girls, but even girls do not choose teaching as their vocation. The reason given by the students are low pay and teaching is not considered as a status symbol. Teaching is both an art and science. Most institutions do not take much effort to find out if the teacher has teaching skills, passion for teaching and most importantly good communi-

cation skills. Such teachers 'teach' only from the prescribed texts where the concepts are explained briefly and in a simplified manner. Even the most state-of-the-art infrastructure will not yield any results and will not have any impact on the students' acquisition of knowledge and employability skills, if the institution does not have good faculty.

Even a cursory glance at the engineering institutions would reveal the most obvious reasons for the poor quality of novice engineers. As mentioned earlier, most of the faculty in the engineering disciplines are not in the teaching profession because of passion, they take up this profession only as a last resort. Engineering faculty become assistant professors immediately after the completion of their master's degree and their knowledge is questionable as they have also undergone a similar kind of education and they lack communication skills and soft skills. This vicious circle continues and leads to further deterioration in the quality of the institutions and the students who graduate from such institutions. Industries are racing against time, facing stiff competitions, flux in the economy and changes in policies of governments in India and abroad; hence, it is not feasible and practically possible for them to spend time, money and resources on training. Moreover, knowledge transfer can be done, but facilitating communication skills and infusing people's skills and behavioural skills may take years, and the companies are unwilling to invest time, money and effort.

"One of the major problems facing the fresh graduates is their insufficient understanding of basic concepts. The lack of in-depth understanding of technical information, lack of client-handling skills and insufficient knowledge across domains are the major skill gaps in the area," says Bharwani (2016) "The lack of ability of the individual to deliver his views effectively at the interview leads to rejection of even the most brilliant candidate. This is because training institutes do not make an effort to ensure that the candidates develop their skills in a wholesome manner which can contribute towards client-handling and team communication skills." Employers have been repeatedly reiterating that graduates do not possess even basic knowledge and the subjects prescribed in the engineering syllabus do not match the requirements of the industry. More significantly, the employers bemoan the lack of people's skills or behavioural skills. A general misconception is that engineers assume that they will be working in isolation doing only technical work, that is, design and technical problem solving. In the article, "What is Engineering Practice?" Sheppard et al. (2016) states vehemently that, engineering "is focused on resolving an undesirable condition through the application of technologies" and hence, "the central activity of engineering work is solving problems." Engineering institutions seem to focus on design and technical problem solving, while forgetting the key point that communicating the design or solution to the client is what employers look for in the graduates. Interacting with their clients, peers, superiors, suppliers, end users and society requires both communication skills and soft skills. Fresh engineering graduates and their superiors with many years of experience spend equal amount of time interacting with their peers.

The study also found that lack of opportunities to participate in extracurricular activities and the focus only on academics is one of the reasons for the lack of soft skills among students. College is perceived to be the best place to develop team spirit and "it is said that possession of team spirit is one of the major skills" (Rao 2010). The most important soft skills expected by the employers are: communication skills, problem solving skills, decision making skills, lifelong learning, leadership qualities, team work dynamics, creativity, ethics, handling criticism and flexibility. Students expressed their views in this regard, while asking them suggestions to improve their soft skills and communications skills. Students are of the view that participating and organizing events in extracurricular activities provides a platform to acquire most of the skills mentioned. Apart from the listed skills students also learn to manage stress, be flexible and adaptable and gain confidence from organizing inter department and inter collegiate events, qualities that help them to be successful at workplace.

Wikipedia defines employability as,

"Doing value creating work, getting paid for it and learning at the same time, enhancing the ability to get work in the future."

Though many studies have provided various definitions of employability skills and industry expectations, the study done by STEMNET (a UK based educational charity) stands

out. According to STEMNET (2010), which conducted a survey among several UK employers, following are the 10 key skills expected by the employers:

1. Communication and Interpersonal Skills
2. Problem Solving Skills
3. Initiative and Self-Motivation
4. Time Management and Stress Management
5. Organizational Skills
6. Team work
7. Ability to learn and adopt
8. Ability to use data and Mathematics to support information
9. Diversity and valuing differences
10. Negotiation Skills

All the above skill sets mentioned by STEMNET, except No. 8 - *Ability to Use Data and Mathematics to Support Information* – are related to soft skills. Educators have a responsibility to embed soft skills training into the regular curriculum. The All India Council of Technical Education (AICTE) (2018) cognizant of this has listed some of the skill sets that are expected by the employers: communication skills, problem solving skills, creativity, intrinsic motivation, initiative, interpersonal skills and teamwork. National Board of Accreditation (NBA) (2011) has suggested some skill sets (Table 1) which engineering colleges should impart to their undergraduate students.

In the Programme Outcomes designed by NBA, the focus seems to be on engineering knowledge, design and problem solving and technical knowledge. In comparison, STEMNET focuses on soft skills, as those are the key skills expected by the employers.

Tech Mahindra CEO, Gurnani (2018) in an interview to The Times of India, has said that around ninety-four percent of the Indian IT graduates are not eligible for jobs in the IT companies. While referring to the skills gap in the industry Gurnani said that Nasscom requires six million people in cyber security by 2020, but adds that IT graduates do not have the required skills. He said, "My point is simple, we are not creating people for employment," and explains what he means by skills gap very vividly, "The point is if I am looking for a robotics person and instead I get a mainframe person, then it creates a skills gap."

It is generally assumed that technical skills and knowledge of engineering subjects is a prerequisite to get jobs, while communication skills and soft skills are required not only to be employable but also to retain the job and to have a successful professional career. Mann's research in 1918, "A Study of Engineering Education," formed the basis for further research conducted by Harvard University, the Carnegie Foundation and Stanford Research Center. It is indeed a very disturbing situation and unemployability could lead to societal problems and instability in the economy, it is alarming that around 1.5 million engineers graduate every year. The gaping chasm between what the engineering education and the industry's actual requirements spells disillusion and fear among fresh young engineering graduates, as they are compelled to seek alternative occupations.

The employers bemoan the lack of soft skills in fresh graduates but seldom are the topic addressed in engineering institutions. Institutions are sending out novice engineers to a skill-driven world. Klein and Alan (2015) (Global Educational Consultant and CEO, PRINCIPLED Learning Strategies, Inc.) has this to say about the existing educational system, which is applicable to our engineering curriculum too "We need to equip students with skills, knowledge, and empathy that will make constructive leaders in a volatile future. We thought educators could guess what would be important in 20 years. This was the industrial age model – to assume that we know what kids need to know. Now I expect to see education give kids 21st century skills, glo-

Table 1: National Board of Accreditation (NBA 2011)

Attributes of undergraduate engineering education			
1	Engineering Knowledge	7	Environment and Sustainability
2	Problem Analysis	8	Ethics
3	Design and Development Solution	9	Individual and Team Work
4	Conduct Investigation of Complex Problems	10	Communication
5	Modern Tool Usage	11	Project Management and Finance
6	The Engineer and Society	12	Life Long Learning

bal competencies, and inter-cultural competencies that make them good at collaborating with each other stakeholders who have different needs. It is controversial in educational circles to not stress content. Teachers always talk about values and behaviors and skills, yet they usually teach to the knowledge component."

Data collection and analysis is still ongoing, education system keeps evolving, technologies, workplace attributes keep changing and workforce requirements keep fluctuating, hence, continuous study needs to be carried out to meet the global challenges and create a framework to help fresh graduates become employable. College administrators must be aware that the employers do not look for the reputation of the institution; they are willing to recruit students from any college who possess all the prerequisites required that the industry expect. Hence, colleges should train students in the necessary skills and create an environment where students can hone these skills.

Formal and informal interactions with the employers revealed that there is a shortage of soft skills, spoken communication and work ethics. Employers say they do not have the time or the resources to train the fresh graduates in these skills, as acquiring these skills could take a very long time. Almost all those who participated in the survey are of the view that they just cannot have unproductive employees. Employers defend their demand for graduates who are work ready by saying that financial crisis and slow growth, client demand, deadline and so on are some of the reasons why they need graduates who have the necessary skills to work immediately. The employers also informed that even when the economy recovers, young graduates would continue to be unemployable if they do not have the skills the employers demand. Finally, they are of the opinion that it is a Catch - 22 situation, because young graduates have not developed workplace relevant skills, either during or after graduation to make themselves employable.

CONCLUSION

Curriculum developers, AICTE, MHRD, the industry and the institutions need to work collaboratively to launch multiple initiatives in assessment methods; imparting new skills and a nuanced and multilateral approach will enable progression. The curricula could be framed with the collaborative efforts of the best in the academia and the industry, to ensure transfer of knowledge efficiently and effectively to the students. Anna University has taken a step towards revamping engineering education, by making some changes in the new syllabi in the year 2017. New courses are being offered to facilitate institute-industry collaboration, and other initiatives have been introduced that would enhance the quality of education. The way we teach has undergone some changes and is continually evolving, but the way we measure and assess students' achievements remain the same. Many surveys conclude that employers strongly advocate integrating soft skills into technical education and soft skills is ranked as the most in-demand skills employers look for.

RECOMMENDATIONS

Imparting of communication skills and soft skills should start at the school level; and colleges should take it to a higher professional level and resolve the lacuna that exists between the academia and industry. It is undoubtedly the responsibility of the engineering colleges to implement the best practices to improve the employability of the students. It is reasonable to conclude that there is no single silver bullet that can change pedagogy; we need to orchestrate a multilateral approach. The changes in the curriculum must be more dynamic, the curriculum developers must bear in mind the fast changing needs of the industry in India, and globally. Finally, education should change the lives of the students. This study reiterates the need for the colleges to arrange for interactions between students and the employers from the second year of the engineering course, so that they can address and discus issues on how the smooth transition from student to employee could be done effectively.

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