

Integrating Humanities and Liberal Arts in Engineering Curriculum: Need, Experiences and New Directions

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ABSTRACT

Engineering curriculum in India, by and large, focuses only on imparting education in the respective technical domain. While such a system has been producing reasonably competitive technocrats, it has not reflected much upon the concept of producing well-rounded engineers. An integration of different streams of knowledge- especially liberal arts, humanities and social sciences - in the engineering curriculum would add this missing dimension. Further, the changing contours of an engineer's profession have made it necessary for one to broaden one's outlook and to be able to connect with the rest of the disciplines. Educators world over have started recognising the importance of creativity and critical thinking which are an integral part of liberal arts, humanities and social sciences. In the western context, there has been a greater emphasis on including these courses in the engineering curriculum. In the Indian context, very few institutes have made some niche efforts in including humanities components in their course package. And often, courses in communication, technical writing, principles of management etc. are counted as the only components in humanities. It is very rare for Tech schools to either have open electives or compulsory credits in humanities. This article discusses how important it is for us academics in India to look beyond imparting mere technical education and to include courses in the areas of liberal arts, humanities and social sciences. Further, it looks at how courses in creative areas that integrate science and technology with liberal arts need to be designed and offered. The article draws from the authors' experience of formulating and teaching such courses.

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INTRODUCTION

Engineering curriculum in India, by and large, focuses mainly on imparting education in the respective technical domain. While such a system has been producing reasonably competitive technocrats, it has not reflected much upon the concept of producing well-rounded engineers. An integration of different streams of knowledge- especially liberal arts, humanities and social sciences - in the engineering curriculum would add this missing dimension. Further, the changing contours of an engineer's profession has made it necessary for one to broaden one's outlook and to be able to connect with the rest of the disciplines. Educators world over have started recognising the importance of creativity and critical thinking which are very much integral part of liberal arts, humanities and social sciences. They have expressed the view that engineering education is not merely about producing an assembly line of technically trained personnel, but is also about creating engineers who are sensitised to the finer aspects of life, have humanitarian considerations and possess a global consciousness. In the international scene there is a greater awareness in this respect. Engineering curriculum in many renowned universities across the world already have humanities, liberal arts and social sciences component. Further, when administered, components such as these have been found to have broadened the students' outlook, nurture critical thinking and creativity. A student who undergoes such holistic education is able to look beyond and does not remain confined to a single stream

of knowledge. Such students are said to be better prepared to face manifold challenges. As noted by Samuel C. Florman in his book *Engineering and the Liberal Arts*, a liberal education enlarges intellectual capacity, develops mental agility, improves our ability to think (Florman, 1968).

In the Indian context, it is very rare for Tech schools to include humanities in their course package. Very few institutions have made some niche efforts in this. While institutions like IITs have a few compulsory credits, some other institutions have open electives in humanities and other related areas. However, in most cases, courses in communication, technical writings, principles of management, etc., constitute the bulk of humanities components. While in the last ten years or so, Indian educators and policy makers have realised the need to re-look at our engineering curriculum, we are yet to see any significant step in this direction. The 2008 National Knowledge Commission Report of Working Group on Engineering Education identifies how humanities can play a central role in character building of engineers. The report recognises the growing need to integrate humanities courses in engineering education.

This article discusses how important it is for us academics in India to look beyond imparting mere technical education and include courses in the areas of liberal arts, humanities and social sciences. It also looks at a new dimension of offering courses in creative areas that integrate science and technology with liberal arts. The article draws from one of the author's experience

of teaching elective courses in the area of Short Film and Video Production and Critical Analysis of Literature and Cinema (CALC). It also draws conclusions from the results of a survey conducted by her on the students of the course CALC over a period of two semesters.

INTERNATIONAL AND NATIONAL STATUS

In various American and European universities, the engineering curriculum is designed in such a way that a student is exposed to various 'freshman' courses in humanities in the very first year of education. They also provide a pool of electives in humanities including liberal arts from which a student must choose a few to complete course requirements. The concept of integrating humanities into engineering education goes back to the early 1940's. Carnegie Mellon University's effort in this direction is a pioneering one.

Strong arguments were put forth by Samuel C. Florman (1968) in favour of including liberal education for engineers in his book *Engineering and the Liberal Arts*: 'a liberal education enlarges intellectual capacity, develops mental agility, improves our ability to think' (O'Neal & Ben, 1990). He quotes Lewis Mumford who warned that a concentration on pure technical training defeats even its immediate purpose by depriving original minds of the stimulus and enrichment of wider interests and activities: "plainly the self-sufficiency of the specialist's world is a prisoner's illusion. It is time to open the gates" (Mumford,

1964, p. 22, as cited Florman, 1968, p. 4). Florman effectively substantiates his stand for inclusion of liberal education in engineering curriculum by terming liberal education as a tool which not only improves a student's intellectual competence but also develops those qualities of character and personality which make for leadership and successful careers. Further, he validates that it enriches an engineer's personal life with new knowledge and insight, with a keener appreciation of beauty and thus can also elevate the standards of an engineer's profession and help him gain an increased esteem in the society.

More recent recommendations from Accreditation Board for Engineering and Technology (ABET), the recognized U.S. accreditor of college and university programmes in applied science, computing, engineering, and technology also highlights the relevance of such courses in the contemporary scenario: "the humanities and social sciences must be planned to reflect a rationale or fulfill an objective appropriate to the engineering profession and course work in the humanities and social sciences must be an integral part of the engineering program" (quoted in O'Neal, 1990).

It is worth noting that one of the top most ranked engineering institute of the world, Massachusetts Institute of Technology (MIT) has evolved very engaging interactions with humanities and it offers a humanities programme of considerable depth while allowing for continued serious commitment to a scientific or engineering interest. Many institutions in

the United States of America have realized that the current trend towards complex, highly integrated systems and global markets calls for future engineers who are more broadly educated, more flexible and more sensitive to the non-technical concerns. Williams (2002) advocates the integration of engineering education with general education. In her book *'Retooling: A Historian Confronts Technological Change'*, she writes, "The convergence of technological and liberal-arts education is a deep, long-term and irreversible trend. Students need to be prepared for life in a world where technological, scientific, humanistic, and social issues are all mixed together...only a hybrid educational environment...will prepare engineering students for handling technoscientific life in a hybrid world." (Charyton & Merrill, 2009) A similar view is expressed by the Liberal studies division of the American Society for Engineering Education publication, 'White Paper on Liberal Studies in Education' (cited in Williams, 2002), "study in non-technical disciplines also gives students a better understanding of the society in which their technical products will be used' and 'it helps students develop the character, understandings and skills needed to formulate, analyze and solve technological problems in a thoughtful and responsible way, within the context of society's structures and mores" (Charyton & Merrill, 2009). The idea is further explored by C. Judson King in the article 'Let Engineer's go to College'. He argues that the challenges that engineers will face in the 21st

century will require them to broaden their outlooks, have more flexible career options, and work closely and effectively with people of quite different backgrounds. Engineering education, instead of focusing narrowly on technical skills, needs to develop a more comprehensive understanding of what they will do as their careers open up. Engineers are to take a greater variety of courses in their college years (King, 2006).

The above discussion makes it clear that the need for having meaningful integration of humanities and liberal arts in general is widely recognized in the global context. However, the issue of including those courses with high creative quotient still needs to be explored. The inclusion of such courses that nurture creativity in engineering students is not very common. Of the little literature available regarding this, the article 'Assessing General Creativity and Creative Engineering' by Charyton and Merrill in the April, 2009 issue of the Journal of Engineering Education makes a strong case for such inclusions. The article notes that many engineering programs appreciate and value creativity, but few offer courses that teach about creativity. They further add that a growing interest in the need and utilization of creativity in engineering design is evident, "more recently, creativity has received greater attention as a necessity, rather than an accessory in engineering design" (2009). The authors quote Ishii and Miwa who put forth their view that creativity education is critical in engineering education as well as general education and including stimulating activities can encourage creativity and

innovation. They further note that learning through meta-cognition and self reflective activities address creativity in education (Ishii & Miwa, 2005, as quoted in Charyton & Merrill). Chensheng Wang (2007) in his article 'On the inspiration of Creative Thinking for Engineering Students' argues that creativity is the soul of design; and in education, to foster the creativity of engineering students with design major is the pivot points leading to the success of teaching. Charyton and Merrill conclude that skills that foster innovation, such as creativity, should be a component of the curriculum so that students can practice and develop these skills.

Engineering education in India for long has been inward looking. However, some efforts have gone into examining the suitability of engineering curricula across Indian universities. It is more than ten years that Department of Education, Ministry of Human Resource Development, Government of India compiled and reviewed 50 years of Indian Education from 1947-1997. This report, in its section on the role of various departments, recognized the need to define the objectives of the humanities and social science programmes in technological institutions. It further suggested that the objectives of these programmes may be looked upon from the perspective of the requirements of the training of an engineer, the role of liberal education in the all-sided development of the learner's personality. Further, the report highlighted that these programmes should contribute by fulfilling the requirements of

the training of an engineer as an engineer by playing an important role in the all-sided development of the learner's personality and by strengthening an engineer's national outlook. This report thus emphasizes the development of social sciences in the special milieu of technological institutions of higher learning.

Recently, National Knowledge Commission report of working group on engineering education too discusses how central a role Humanities can play in character building of engineers. The report recommended that undergraduate engineering curriculum should have 10% credit for humanities and social sciences. One of its recommendations goes, "The current curriculum should be modified to provide flexibility, interdisciplinarity and choices of electives" (NKC Report on Engineering Education, 2008).

Prof. R. Natarajan, an academician and the former director of AICTE, in his editorial 'An Indian Perspective on Engineering Education Reform' for the Journal of Engineering Education emphasizes that the output requirements of 21st century engineers include the pursuit of life-long learning, ability to acquire knowledge from neighbouring disciplines, ability to work in teams, creativity and innovation, integrative skills, international outlook etc. (Natarajan, 2008).

HUMANITIES' INTERACTION WITH OTHER DISCIPLINES

In this era of multi-disciplinary approaches and converging technologies, no discipline

can afford to flourish in isolation. It requires one to be exposed to various knowledge systems as the boundaries between different disciplines overlap and converge at an unprecedented pace.

Apart from the conventional areas in humanities, newer opportunities have opened up in areas like digital arts, media arts, digital humanities, television, new media, etc. that require collaborations in art, music, technology, computer science, designing, architecture and so on. The booming entertainment industry across the globe, the world of digital films, animation, and construction of virtual reality necessitate meaningful dialogue between technocrats and artists. At present, art and technology integration and collaboration is resulting in hybrid art forms with mass utility and appeal. Digital media-art practice is one specific example. It can be considered a hybrid art form with distinctive roots in a number of historically separate knowledge bases (Legrady, 2006).

While there are a good number of innovators engaged in such integrations and hybridizations, there have not been many efforts to study the whole process involved in it. Today, there is a worldwide community of innovators engaged in convergence of art, technology and science, yet, there seems to be very little discourse about the process of doing interdisciplinary work (Pearce, 2003).

In such a scenario engineering institutions become ideal incubators for new directions in such interdisciplinary work as they already have a critical mass of technically sound students. An engineer's

interaction with humanities and liberal arts will not only nurture their creative and critical faculties, but would also leave the pedagogy of liberal education enriched.

DRAWING FROM OUR EXPERIENCES

We at the Departments of Languages and Humanistic Studies at BITS, Pilani, have been offering elective courses in various areas of humanities, social science and liberal arts for more than four decades now. Apart from a number of courses in the areas of traditional humanities and liberal arts, in the recent years, we have introduced courses like also ha The freedom to offer newer electives in one's area, university has always encouraged its faculty to offer different courses. One of the elective courses is Critical Analysis of Literature and Cinema, which is being taught by the first author (since January 2004) for the students of engineering and sciences makes an interesting case study. The course has grown in number, in the interest from a class of merely 4 in the first semester of its offering to the present where we run it full house. Over the semesters, we have increased the number of seats available and this semester, the upper cap has been put at 60.

In the following section, a survey that was conducted last year on a sample of 30 students to find out the feedback of students at the end of the semester will be discussed. The questionnaire covered areas of students' satisfaction, fulfilling of objectives, course plan, methodology, evaluation scheme, relevance of contents

included, etc. The questionnaire included six questions that were very specific to the relevance of offering such courses in Tech. Schools. The responses to these set of questions substantiate how right we are in recognising the role of humanities in engineering education.

One of the questions asked the students to fill in the reasons for taking up the course even if it is not compulsory to do it. The responses to it bordered around the idea of exploring a non-technical course. Some viewed it as an opportunity to learn new perspectives, some as a break from technical courses, and a few as an avenue to meet like-minded people.

The pie chart shows the responses of the students to the question if the course enhanced their critical thinking ability and if yes, in what way. Of the thirty respondents, 28 said 'yes' and only one of the students felt there was a slight difference as he/she understood more aspects. One student left this question unanswered. Also, the many responses indicated that the course broadened their insights. One response said 'it makes a difference to one's emotional quotient'.

Similar responses were given to the question, 'Is it important to have courses like CALC in a technological institute. If yes, why?'. Ninety seven percent of the respondents said 'yes' and one did not respond. They further validated their views with responses like 'very important', 'tremendously important', 'Technocrats are also human beings' and so on. They felt such courses enabled 'holistic

well-rounded development', tap creative potential, developed different sensibilities, rejuvenated by providing a change or by giving a diversion. Meanwhile, a few felt they are inspiring and stimulating to one's artistic side. One response read this, 'art combined with technology can do miracles for filmmakers.'

On the question, 'Do you think the skills you acquired/knowledge you gained in this course are going to be useful in future?', surprisingly 87% of them said 'yes, definitely'. Three of them said they could not say for sure, one said 'he/she did not think from that angle' and one did not respond to this particular question.

When asked, 'Do you think courses like CALC make any value-addition and enhance one's quality of life in any way? If yes, mention how', 25 respondents (83%) gave a 'definite yes' for an answer. One of the respondent said 'broadly no, but could influence the way we look at people', four of them did not respond to this question. One response stood out which said it 'makes one think beyond the inane technology and science. Makes one talk to himself. Makes one introspect which Science and Technology utterly fails to'.

Although this particular study used only a small sample, it could draw one's attention to the relevance of the courses in humanities and liberal arts in technical education. The study is ongoing and at the end of this semester I will have more data from students who have done the course. While it has to be kept in mind that this is a response only to one of the courses taught at BITS, Pilani

and that it cannot be generalized for all, the fact remains that a course well-designed and well-delivered makes a huge difference to the students in an engineering and science student.

FUTURE DIRECTIONS

While a few engineering institutions already have included courses in humanities, social sciences and liberal arts in their curriculum, a few steps would make such engagements more fruitful. It is important to understand that as educators, we have to make a few choices.

To have the humanities and liberal arts departments supporting other departments. Overall, inclusion of courses in engineering will enhance the quality of engineers in a big way, make them socially and culturally aware and enhance their critical and creative thinking. However, to have a dynamic department with its faculty engaged in serious pursuits is important. They also need to have an environment that supports research and teaching in their own areas of expertise.

To have departments that are fashioned in the traditional way. These departments are engaged in their own domain, looking inward while they offer a few courses for the whole population. In such a scenario, while we may have strong individual departments, we may not be tapping the potential of drawing from the existing strength and technical expertise.

To have cross departmental engagements where students and teachers of different discipline interact, teach, learn and take

projects that require expertise of people from different knowledge domains. This seems to be a win-win approach for all who are engaged in such engagements.

The last option is not worked upon in our institutions though it has a lot of merit about it. Collaborations between departments will enhance the teaching, learning and research involvement as ideally strong departments that not only look inward but also outward will be able to think of newer approaches and solutions to the complex problems of our times. In one of my discussions with a faculty colleague from another department, the point of engaging with areas like Exact Humanities, Computational Linguistics/Humanities came up. These areas are situated at the interphase between humanities and exact sciences and hence cross departmental collaborations are the only ways in which these disciplines can be studied and taught. Research/ teaching collaborations between faculty resources from Languages, Mathematics, Computer Science, Fine Arts, etc., would result in newer directions in such a scenario.

CONCLUSION

The aforesaid observations and recommendations indicate the need for new approaches while designing engineering curriculums. The importance of having a holistic engineering education that includes exposure to different subjects of humanities like social and behavioral sciences, economics, liberal arts, philosophy, psychology, etc. is being understood. However, in the Indian context,

not many efforts have been made for such integration. As mentioned earlier, the inclusion of humanities courses have so far been mainly targeting at making engineers better communicators and better managers. Most of the institutions and universities have very few humanities faculty and they are involved in teaching basic courses in professional communication, functional English, principles of management, report writing, etc. In this context, the concept of introducing elective courses in humanities is tried out only in a few institutions. Even in such institutions, there have not been enough efforts to tap the interdisciplinary potential of emerging areas in humanities, to think of ways to integrate creative areas into the engineering curriculum. Courses in the area of digital film, animation, media content design, creative writing, photography, music, and other performing arts, use of technology in creating art, etc., hold a great deal of potential and add newer dimensions to the topic of discussion.

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