

Need of Non- Technical Content in Engineering Education

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I. Introduction

The foundation of engineering education has its root in the basic sciences. The knowledge of basic science is the backbone of all technical education. It is the base on which the building of innovations, ingenuity and research stands. The first introduction of engineering is always through sciences i.e. through physics, chemistry and mathematics. Engineering is the bridge between the sciences and humanities. It is observe that engineers apply scientific principles to advance the human condition, but their success relies as much upon an understanding of physics and mathematics as an appreciation of history and psychology. The main objective of this paper is to emphasize the importance and pertinence of basic science in engineering programs, not with the objective of providing a cultural complement but with the idea of giving the students a strong basis in this area, in order to provide them with adequate continuity along with engineering and applied engineering. This will allow them to adapt better to technological changes and advances.

Engineers play an important role in the development of nation. In the contemporary scenario, engineers have to face new challenges which require more than just technical knowledge. They are expected to be more versatile and possess essential non technical skills as their work profile will require them to deal with professionals in various streams. An additional but very important complement in engineering programs is social-humanistic subjects. It is an essential part of education, so that the future engineer is increasingly aware of the problems of the society he is endeavoring to build and the environment in which he will develop as a professional. It is important to consider that it is not enough to transfer knowledge to the student but he should also develop soft skills and attitude; for this purpose, humanistic education is quite important. It is true that the student has learnt all this in high school, but certainly with a different degree of maturity, and a basic one if anything.

This is also reflected in the report of the review committee appointed by National Academy of Engineering USA that graduates will have to look at economic, political, ethical and social constraints as boundary conditions that define the possible range of solutions for future engineering problems (NAE 2005). Therefore, future engineers need to have a better command over different types of societies, economies, governments and cultures.

II. Importance of non technical content:

A review committee appointed by the National Academy of Engineering in the United States argues that graduates must now consider economic, political, ethical and social constraints to be boundary conditions that define the possible range of solutions for future engineering problems [7].

Engineering projects are now executed by teams whose members come from different countries but the success of such global projects depends not only on technical skills but on the aspects of communication and teamwork skills as well. The revised accreditation frameworks in many countries including that in USA and Australia demonstrate the growing global emphasis on broadening the base of engineering knowledge with focus on interdisciplinary and non-technical knowledge [5]. In order to develop the thinking and understanding level of the technical people it is very necessary to introduce some genre of literature like poetry, fiction and drama in the engineering curriculum. In this manner the non technical elements help and make the minds of engineering professionals more luxuriant and fertile

Engineering education must develop a broaden outlook and should be attuned to the real concerns and communities. Courses should promote environmental, economic global awareness, problem solving ability, engagement with information technology, self-directed learning and lifelong learning communication, management and teamwork skills, but on a sound base of Mathematics and Engineering Technology. For engineering graduates to take a more effective societal role, they must be better communicators. This means that, in addition to having the ability to explain technical problems, they must be politically and socially aware so that technical decisions can be made, understood and communicated with sensitivity, especially across cultural boundaries [6]. If a person is having proper understanding of these two aspects of life, then it will be cherry on cake.

To define an engineer as a 'complete engineer' (Graff and Ravesteijn 2001), 'rounded engineer' (Rojter 2002) and 'new engineer' (Conolon 2008), meaning engineers with sufficient knowledge of societal, cultural, economic and environmental contexts which surround the engineering projects and processes. The

purpose of non-technical subjects is to enrich and complement engineering education (Graff and Ravesteijn 2001). All in all, globalization and sustainable development have further increased the importance of non-technical subjects in the curriculum to satisfy the industrial and societal requirements of 21st century.

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III. Basic Science Subjects:

The basic science consists of a group of subjects like Physics, Chemistry, Mathematics, Computer application, Economics, Accountancy etc. Finally, another fact that must be considered is the importance of basic sciences in the development of reasoning abilities; an exercise that is very much essential at every step of the professional activities. Engineers use their knowledge of Science, Mathematics, Logic, Economics, and appropriate experience or tacit knowledge to find suitable solutions to a problem.

Mathematics is an integral part of engineering, what so ever branch of engineering is chosen. Thus, pure science is the roots of all technical streams. The use of chemistry within the field of engineering can broadly be divided into two main areas. The first area is concerned with the application of chemistry as the basis of power generating machinery, such as combustion engines, for example. Knowledge of chemistry and chemical reactions is required in the design and subsequent production of such power generating equipment. The second area of use is chemical engineering, where the main purpose is to transform raw materials into more valuable or useful forms.

Physics is the discipline devoted to creating and optimizing engineering solutions through enhanced understanding and integrated application of mathematical, scientific, statistical, and engineering principles. Therefore many universities of foreign countries are running a course of engineering Physics like:

Princeton University, Harvard University (Engineering Physics is a 'track' within Engineering Sciences in the School of Engineering and Applied Sciences at Harvard.) UC Berkeley (This is a program within Engineering Science), Colorado School of mines (Engineering Physics is the only undergraduate degree offered by the Dept of Physics at CSM.), Cornell University (This undergraduate program is within the school of Applied and Engineering Physics), University of Toronto (Engineering Science), University of Wisconsin, University of British Columbia, Case Western Reserve, Ohio State University, Stanford University.[13] A short term course on the role of basic sciences in engineering education under self-financed category was inaugurated by the Vice Chancellor of the University of Allahabad, Prof A K Singh in the Seminar Hall of Motilal Nehru National Institute of Technology, Allahabad. He was of the opinion that the role of basic sciences in developing technologies is on boom but the development of these technologies should be simple.[12]

IV. Examples of some foreign universities:

ABET [1] currently US engineering institutions to ensure that non-technical subjects make up at least twenty percent of an engineering degree. However, an analysis of the curriculum of several US engineering institutions reveals that, many institutions actually have more than that. For example, Massachusetts Institute of Technology has twelve non-technical subjects in its engineering degree, including eight from humanities and social sciences, and four related to communication skills, which is more than ABET prescribes. Stanford and Cornell both prescribe one compulsory subject that relate to technology and society. And Georgia Tech allocates twenty four credit points for non-technical subjects: twelve credit points for social sciences, with compulsory components from ethics, history and constitution.

Australia's Queensland University of Technology recently introduced a compulsory course for all engineering students that examine the main aspects of sustainable living as they relate to the engineering profession.

Due to the centralization of the higher education sector, India's curriculum of engineering reforms is much more challenging than those of most Western countries.

V. Employment factor:

The quality of India's engineering education has been questioned by industry as well as international benchmarks [4]. The main problem is that of employability. Studies have indicated that only one in four graduates from India's colleges are employable. A National Association of Software & Services Companies (NASSCOM) study found that India still produces plenty of engineers...400, 000 a year. But most are deficient in the required technical skills, fluency in English or ability to work in a team and deliver basic oral presentations [11]. It is worth noting that NASSCOM is not arguing the technical content of the curricula but is arguing that more than 70percent of graduating engineers are unemployable due to a lack of non-technical knowledge and skills.

VI. Conclusion

This study found that the need of non technical contents in engineering education is like the need of salt in food. An appropriate ratio of non technical contents is obligatory to make the engineering education more effective and productive. Non technical skills develop entrepreneurship, self-awareness, innovation, team spirit, negotiation skills and communication skills in an engineering professional. A solid understanding of globalization is the key to an engineer's success in today's global society. Globalization involves the ability to understand that the world economy has become tightly linked with much of the change triggered by the technology; to understand other cultures, especially the societal elements of these cultures; to work effectively. In summary, it appears that despite its important role in graduate attributes and course outcomes the quantity of the non-technical component of the engineering curriculum is not a standard one. The huge disparity among countries regarding the quantity of non-technical as well as technical content may pose problems in equivalence of degrees, credit transfer and mobility of engineering graduates.

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