



Fifty Years of Electrical Engineering Education: Teaching, Research, and Assessment

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The paper recognizes and discusses three major - and interrelated - tenets of engineering education, as listed in its title. After presenting a brief historical perspective of electrical engineering education during the twentieth century, the paper discusses trends, and their underlying factors, in undergraduate education in the field during the past 50 years. The paper's observations and conclusions are derived from both institutional and personal experiences by the author during his more than 50 years of involvement with the subject at several institutions of higher education world-wide with diverse characteristics. Specific examples from educational developments and experiments conducted in several universities are reviewed, while some case studies are analyzed in more detail. The aim of the paper is to provide insight into this area, which would help improve existing programs and guide planning and implementation in future curricula for undergraduate electrical engineering. To a large extent, the discussion and conclusions in this paper may be extended to other fields in engineering as well. The presentation contains four parts, as summarized below.

1) Mission and Goals. The first part of the presentation reviews and discusses mission, goals, and objectives of an undergraduate engineering education. Mission statements, whether implied or explicitly expressed, constitute the governing force behind a program. After a brief survey, the paper classifies attributes of mission statements and identifies their promises and pitfalls, including possible contradictions contained in them.

2) Curricula and Delivery Systems. The second part of the paper is concerned with design of curricula, their restructuring and rejuvenation, and their delivery. New communication and computer technologies have influenced both the contents of undergraduate engineering education and their delivery systems. In this respect the following are of special interest: a) Historical shifts of curricular components (sciences, general education and breadth, general engineering, core EE courses, and technical electives) and their correlation with landmarks in EE technology development; b) The power and limitations of delivery systems, including use of new communication and computer technologies and the internet, and students interaction with computers; c) Innovative instructional methodologies such as project-based learning; and d) The increasing role of research by faculty and students.

It will be argued, and shown by examples, that project-based learning and undergraduate research may often be intertwined to produce extraordinary educational benefits. In this part we also examine and analyze several historical predictions of engineering educations made during the past 50 years and derive lessons from them. The discussion touches upon the author's personal experiences with examples ranging from establishing a new program to updating existing ones.



3) Students. The third part of paper looks at the student body in general and qualifications of incoming freshman in particular. Students' learning models and their motivation are at the core of this part of the paper. The author believes the freshman year plays a very important but often overlooked role in a student's learning experience and deserves greater attention in curriculum design. Historical trends and recent steps to introduce freshman courses at several universities to motivate the students and at the same time teach them the fundamentals along with applications are reviewed.

4) Assessment and Conclusions. The paper introduces an example of structured assessment methodology for accreditation purposes. It then reports on some results of the author's longitudinal evaluation and in-depth interviews with some of his former colleagues and students, from new graduates to some who have practiced the engineering profession for up to fifty years. The paper concludes by presenting a set of environment-invariant recommendations.