

Outcome Based Engineering Education for a Sustainable Future

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Abstract

One of the major responsibilities of engineers of our age is to find innovative solutions to the challenging issues, such as fast depletion of energy and material resources, environmental problems, global warming etc., to shape a sustainable future. Curriculum and teaching strategies of engineering education should be designed to educate more creative and innovative engineers with certain skills, competences and the abilities in order them to be able to find innovative solutions to global challenges. Outcome based design of engineering education curricula should consider the required knowledge, skills and attitudes that students must have acquired by the time they graduate. Evaluation and accreditation of engineering programs require the presence of an assessment process in order to determine and document how far program outcomes are being achieved. The major objective of this process is continuous improvement.

1. Introduction

Increase of world population to 9-10 billion, significant increase of energy and electricity demand, fast growth of world GDP and significant increase in carbon emissions are some of the most pressing issues of the next decades. Need for renewable energy resources, fast depletion of material resources, availability of affordable food supply, need for clean water, environmental problems created by toxic generation and dispersion, waste management and global climate change are some of the global challenges facing our planet. All of these challenges require engineering solutions. To tackle such global challenges will be the major responsibility of the engineers in the next decades. One of the major responsibilities of engineers of our age is to find innovative solutions to these challenging issues to shape a sustainable future. We should be aware of not compromising the ability of future generations, while depleting the energy and material resources. Sustainability requires design of new systems, units, processes consuming less energy, less raw material, producing less waste and which are less risky and less costly. For the product side, sustainability requires new products which are tailored more recyclable, more environmental friendly and more knowledge based. In order to be able to confront these challenges, curriculum and teaching strategies of engineering education should be designed for more creative and innovative engineers.

2. Attributes that engineering graduates should acquire

Many of the global challenges are complex issues, requiring for its solution in-depth engineering knowledge, abstract thinking, creative use of basic engineering principles, development of new models or methods and research based knowledge at the forefront of the engineering discipline. Besides having a strong background in mathematics, sciences and engineering subjects, the engineering students should develop number of skills, competencies and the experiences during their education in order to be able to find innovative solutions for global challenges.

Some of the important attributes, that graduates of engineering programs should have developed are; the ability to formulate, analyze and solve complex engineering problems; ability to devise, select and use modern techniques and tools and information technologies; ability to design a complex system, process, device or product, ability to design and conduct experiments, gather data, analyze and interpret results; ability to work efficiently in intra-disciplinary, multi-disciplinary and multi-cultural teams; ability to communicate effectively; recognize the need for lifelong learning, ability to access information; awareness of professional and ethical responsibility; knowledge about project management, risk management; awareness of innovation and sustainable development; knowledge about contemporary issues and the impact of engineering practices on health, safety, environment etc.[1-3]. One of the most important attributes that the graduates of engineering programs should have developed is the design ability for units, processes, systems or products under realistic constraints, such as economic and environmental issues, sustainability, manufacturability, ethics, health, safety

and social issues, according to the nature of the design. In finding solutions to such global challenges, the engineers should be aware of the impact of their solutions on PLANET and PEOPLE, besides the economic constraints.

3. Evaluation and Accreditation of Engineering Programs in Turkey

MUDEK is an association for evaluation and accreditation of engineering programs in Turkey. It is a non-governmental organization operating for the purpose of contributing to the enhancement of quality of engineering education in Turkey, by means of the accreditation and evaluation of engineering education programs in different disciplines. It is a member of ENAEE (European Network for Accreditation of Engineering Education) and also a full signatory of Washington Accord of IEA (International Engineering Alliance). The evaluation and the accreditation process of MUDEK strongly depends upon the attributes that the graduates of engineering programs should have acquired by the time that they graduate. These outcomes are in agreement with both ENAEE EUR-ACE framework standards and Washington Accord graduate attributes. Such outcomes define the attributes that the engineering graduates should have acquired, in order them to confront and find innovative solutions to global challenges. A review of such outcomes will be given in this presentation.

3. Concluding remarks

Engineering programs should be able to demonstrate that their graduates have acquired such attributes as well as research based knowledge at the forefront of their field. The programs should be designed to educate more proactive and innovative engineers. This will require curriculum design and teaching strategies to include challenging realistic open ended projects, team work studies, involvement of industry etc. Programs should also periodically determine and document to find out how far the program outcomes are being achieved. The results obtained through these assessment procedures should be used for their continuous improvement. It is the responsibility of each program to achieve the required attributes that students should have acquired by the time they graduate. How we teach is at least as important as what we teach.

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References

- [1] [http://www.mudek.org.tr/doc/en/MUDEK-Evaluation_Criteria_\(2.0.1\).pdf](http://www.mudek.org.tr/doc/en/MUDEK-Evaluation_Criteria_(2.0.1).pdf)
- [2] [http://www.mudek.org.tr/doc/en/MUDEK-Evaluation_Criteria_SC_\(1.0.1-17.10.2012\).pdf](http://www.mudek.org.tr/doc/en/MUDEK-Evaluation_Criteria_SC_(1.0.1-17.10.2012).pdf)
- [3] A. B. Özgüler, M. Y. Erçil, A. E. Payzın, B. E. Platin, "[Program Outcomes: The Core of Program Accreditation](#)", *Engineering Education*, *AEER (Association for Engineering Education of Russia) online Journal*, Issue 12, 2013, pp. 26-33. <http://aeer.ru/en/e-magazine.htm>
- [4] http://www.enaee.eu/wp-content/uploads/2012/01/EUR-ACE_Framework-Standards_2008-11-0511.pdf
- [5] Dogu, T. "Outcome Based Curriculum Design for Global Challenges", WEEF2012-World Engineering Education Forum, Buenos Aires, October 2012.