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Teaching Transportation Systems Thinking Concepts to Undergraduates

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Teaching Transportation Systems Thinking Concepts to Undergraduates

Systems thinking is thought by many academics to be a graduate level educational venture. Many traditional educators in the engineering field argue that first a student should gain a grounding in some traditional branch of engineering (civil and environmental engineering, mechanical engineering and so forth) and only after that bachelors degree is attained should students be exposed to systems level ideas. The notion is that without the context of some traditional disciplines, students will find the systems discussions too abstract to be of value.

In recent years, the idea of developing individual subjects, minor programs and major bachelors programs in the field of engineering systems – also known as complex sociotechnical systems– has gained some momentum. Clearly that includes transportation systems

This study looked at the question of what the appropriate components of a new subject offering, intended to introduce undergraduates as early as the freshman or sophomore year, to systems ideas. We developed and taught such a class at MIT, evaluated the subject carefully and wrote several papers discussing the educational outcomes. The results of this research are documented in several professional papers presented at the American Society of Engineering Education and the International Engineering Education Society. The references are as follows:

- Complex Socio-technical Problems for Engineers: Pedagogical Motivation and Experience at the Undergraduate Level (.pdf [ESD-WP-2012-13](#))

Introducing Complex Sociotechnical Systems to First-and Second-Year Students (.pdf [ESD-WP-2011-05](#))

Further, a detailed curriculum was developed for such an introductory subject to be taught at the Singapore University of Technology and Design (SUTD) in September 2013 which can be referenced through the following website.

<http://stellar.mit.edu/S/SUTD/esd101/index.html>

In addition, the team worked on developing the full specification for an undergraduate program in engineering systems. The resource materials can be accessed through the following site.

<https://wikis.mit.edu/confluence/display/ESDwiki/ESD+Undergraduate+Committee>

We ultimately concluded that if students are not exposed to systems thinking early in their bachelors programs in engineering, they may find it difficult to switch to more integrative systems thinking. Much undergraduate education seemed to the researchers to be too heavily weighed to the reductionist (“vertical”) engineering science perspectives now endemic in engineering education around the country and the world. Of course, this approach has value and

should continue, but a rebalancing of curricula to include more integrative (“horizontal”) teaching should take place.

Related work by members of the research team

- Integrating Engineering Systems Research and Undergraduate Education Through A Term-Length Case Study (.pdf [ESD-WP-2012-14](#))