Utilizing the CDIO Syllabus to Reveal CEAB Graduate Attribute Pathways in a Mechanical Engineering Curriculum

Alexandra Meikleham, Robert Brennan, Ron J. Hugo
University of Calgary
Alexandra.meikleh1@ucalgary.ca

Abstract – Many Canadian engineering programs offer courses through a pre-requisite approach: coursework, and therefore knowledge, is assumed to build throughout a program. The pre-requisite approach allows post-secondary institutions to monitor the pathway a student takes throughout a program, and is assumed to be informed by knowledge journeys. In our experience, however, pre-requisites may only be loosely based on scaffolded development of student learning. Course pathways sometimes place a greater emphasis on administrative convenience and historical relationships, rather than reflect an up-to-date or meaningful developmental journey. These “pathways” appear to be particularly tenuous when it comes to professional skills development, despite an increasing emphasis on their importance (see Canada’s Graduate Attributes 6-12 (Canadian Engineering Accreditation Board, 2017)). The pre-requisite model may reinforce a bureaucratic approach to professional skills development, inhibiting flexibility and innovation in course delivery by allowing administration, rather than learning outcomes to guide student learning. For example, some authors have argued that current course-based delivery methods may not be the most efficient mechanism to deliver a constructively-aligned [2] curriculum, and suggest that an integrated approach could be a potential solution to this problem (Crawley et. al, 2014). This paper will discuss the methodology and findings of a detailed outcomes-based analysis of an accredited Canadian Mechanical engineering program. The CDIO (Conceive, Design, Implement, Operate) Initiative is an engineering education framework which offers a syllabus of internationally accepted learning outcomes for the 21st century engineer [3]. Previous work has described how CDIO skills map almost 1:1 to the 12 CEAB graduate attributes (Cloutier et al., 2012), providing a useful framework for learning outcomes indicators. This paper will extend on this work by applying the described mapping to all courses in a Mechanical Engineering program. 73 of the most relevant 102 CDIO syllabus items for Canadian accreditation were used as a mechanism to audit 44 core engineering courses. Each attribute was then identified by the instructor to be covered at a minimum of one of four levels for each of the skill: Introduce, Teach, Utilize or N/A. The identified skills and their associated levels were taken to form the complete basis of skills across our four-year program. By taking this skills-based approach, the actual development pathways for each graduate attribute could be mapped, and interconnectivity visualized a similar approach has been described in [5], [6]. The findings from the mapping exercise will be compared to the existing pre-requisite pathways, and used to inform the development of a “spine” of modules dedicated to professional skills development. The paper will discuss how “professional touchpoints” were revealed through the analysis, and propose a framework for implementation of professional skills modules following this data-driven approach rather than traditional pre-requisite course methodology. This paper will be useful for curriculum and program designers interested in student-oriented approaches to professional skills development in Canadian undergraduate institutions. It will provide a clear description of methodology, how the researchers arrived at their findings, and what criteria were used to identify the program touch-points. The methodology and findings presented in this paper will easily be transferred to accredited engineering schools within Canada, or could be adapted for use at international engineering schools with similar program objectives under the Washington Accord [7].

Keywords: Curriculum Design, Curriculum Mapping, Network visualization, Graduate Attributes, CDIO Syllabus.

References


