CDIO as an Enabler for Graduate Attributes Assessment: A Canadian Case Study

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ABSTRACT

Recent changes to the criteria for engineering accreditation in Canada emphasize continuous curriculum improvement through outcomes-based assessment. In this article, the authors show how the CDIO (Conceive-Design-Implement-Operate) approach not only enables continuous improvement, but can assist Canadian engineering programs with the overall graduate attributes assessment process through a case study of the B.Sc. in mechanical engineering program at the Schulich School of Engineering.

Keywords: *Accreditation, CEAB Graduate Attribute Planning, Conceive-Design-Implement-Operate (CDIO) Syllabus, Graduate Attributes, Outcomes-Based Assessment*

INTRODUCTION

In 2008, the CEAB (Canadian Engineering Accreditation Board) updated their criteria and procedures (CEAB, 2010), moving toward a model that emphasizes continuous improvement as well as program outcomes. Although outcomes-based assessment is a well-established component of many national engineering accreditation boards (e.g., ABET, 2010), it is relatively new in the Canadian context. This is not to say that outcomes-based assessment is not practiced in Canada – other national accreditation boards (e.g., medicine) have been relying on outcomes-based assessment for years and many of our colleagues use it as part of their teaching and learning strategies. However, there is very little experience with outcomes-based assessment among engineering programs in Canada.

In this article, we describe the process that is being followed at the Schulich School of Engineering to address the CEAB's new graduate attributes criterion (Figure 1), and show how the CDIO approach (Crawley et al., 2007) can play an integral role in this process.

The overall process being used at the Schulich School of Engineering illustrated in Figure 1, is closely aligned with the ABET Assessment Planning Flowchart© (Rogers, 2004). More specifically, the CEAB graduate attributes shown in Figure 1 directly correspond to ABET *student outcomes* (ABET, 2010).

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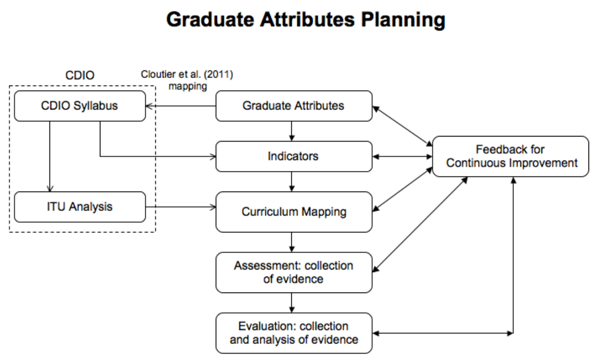
Figure 1. CEAB graduate attribute planning and the CDIO syllabus



- Graduate attribute [are] … generic characteristics specified by the CEAB, expected to be exhibited by graduates of Canadian engineering schools (Engineers Canada, 2011),
- Student outcomes (a)-(k) … describe what students are expected to know and be able to do by the time of graduation (ABET, 2010).

The flowchart at the center and right of Figure 1 shows this general assessment planning process from the accreditation board-defined program outcomes (*graduate attributes* for the CEAB or *student outcomes* for ABET) down to the level of collection and analysis of evidence embodied in classroom assessment and outcomes evaluation. As noted on the right of Figure 1, opportunities for continuous improvement exist throughout the process.

The left side of Figure 1 shows how the Schulich School of Engineering assessment planning process relates to the CDIO approach, and how it builds on the CDIO syllabus mapping of Cloutier et al. (2012).

The main advantage of the approach presented in Figure 1 is that the CEAB's graduate attributes can be linked to the comprehensive CDIO syllabus (Crawley et al., 2011) in the same fashion that ABET student outcomes (a)-(k) have been mapped. More specifically, as shown in Table 1, the CDIO syllabus can be viewed in the context of a typical program assessment planning flow chart (Rogers, 2004) where Level 1 refers to the first level of detail of the CDIO syllabus such as 2.0 Personal and Professional Skills and Attributes) and Level 2 and Level 3 refer to the second and third level of detail, respectively.

It should be noted that this approach does not discount the stakeholder engagement that is inherent to outcomes-based assessment. Instead, the CDIO syllabus is used as a starting point for program assessment and as a means of informing and focusing the discussions around program-specific outcomes and performance criteria. As illustrated in Figure 1, feedback is required at all stages of the process, involving input from educational researchers on assessment design and teaching and learning strategies, engineering educators on direct assessment methods and educational practices and strategies, engineering students via self-efficacy surveys, and engineering employers for input on student outcomes.

Although this addition to the CEAB accreditation requirements may at first appear onerous, if applied properly it can result in a positive environment for, and an enabler of curriculum reform. In this article, we build on our previous work on curriculum mapping (Brennan & Hugo, 2010) and the work of Cloutier, Hugo, and Sellens (2012) to show how the CDIO approach can facilitate this overall graduate attributes planning process.

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