Graduate Attributes: Intentional Mapping and Assessment Portfolios

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Abstract

In 1987, the University of Guelph introduced Learning Objectives for all of its undergraduate programs. In 2004, the NSERC Chairs in Design Engineering released a white paper on Engineering Design Competencies. In 2009, the Province of Ontario mandated University Undergraduate Degree Level Expectations (UUDLEs). And finally, in 2010, the Canadian Engineering Accreditation Board (CEAB) began reviewing and assessing progress towards twelve graduate attributes.

These initiatives are based on an outcomes philosophy towards curriculum development that is distinctly different from our historical, and still common, inputs based approach. Success in a learning outcomes approach relies on engaging students, educators and program leaders and is data-informed, educator- and student-driven, intentional and assessed.

Guelph has been developing a combination of tools and processes to advance learning outcomes pedagogy:

- 1. CurricKit Outcomes Mapping has been created to support intentional curriculum development through aggregating faculty input on course outcomes to a program perspective.*
- 2. Progression Maps have been created to aid in the visualization of a program's curriculum structure, through courses, semesters and program years*
- 3. A Portfolio System has been developed to permit student, educator and program portfolios to be built. These portfolios allow for reflection and for assessment of learning outcomes based on the artefacts of student work.*

This presentation will share current status and Guelph's visions for the future - a future in which

every student has a learning outcomes based portfolio and every program has an intentional curriculum map and a program level portfolio.

By the end of this session, participants will be able to:

- Describe the processes and tools being used at the University of Guelph,*
- Consider how to apply or adapt them for use in their local context.*

1 Introduction

Current educational thinking suggests that outcomes (or attributes) based learning can be understood as a curriculum planning process that considers the impact of discrete learning experiences in the achievement and assessment of often broadly-defined aims for learners [1]. Outcomes often include a wide range of skills and knowledge and can be scaled from individual course to program and to system-wide. This is in contrast to the model of education that focuses on 'inputs' (e.g. number of hours spent in lab).

Outcomes-based education focuses on standards of achievement for each outcome, and assessment is based on individual learners achieving mastery at the desired level for each standard [2]. This can be in contrast to a norm-based assessment process that ranks learners in relation to each others' achievement.

There are two primary motivations for the introduction of learning outcomes [3]. One is driven by accountability (and accreditation) like concerns and two is to advance teaching and learning. Lattuca observed significant improvements in many learning outcomes shortly after the introduction of EC2000 by ABET [4].

An important and challenging element of any learning outcomes approach is to define the learning

level to be achieved. There are many taxonomies to help articulate this level of desired achievement. Bloom's Taxonomy of Educational Objectives (Handbook 1: Cognitive Domain) is most well known in many academic settings [5]. There are also Affective and Psychomotor domains that are lesser known within Bloom's Taxonomy and many other learning taxonomies worth consideration.

In 1987, the University of Guelph introduced learning objectives for all of its undergraduate programs [6]. These ten learning objectives spanned from literacy to moral maturity to independence of thought. The approval of new courses and new programs requires an explanation of the contribution to the learning objectives.

The Province of Ontario has introduced University Undergraduate Degree Level Expectations (UUDLEs) as a requirement for all Bachelor degrees [7]. UUDLEs have been introduced under a quality assurance framework for a variety of reasons including bringing Ontario into line with international standards. The framework attempts to strike the right balance such that quality assurance creates a culture of quality enhancement. Stiver provides a comparison between Ontario's UUDLEs and CEAB's graduate attributes [8].

In 1997, ABET introduced Engineering Criteria 2000 [9]. Engineering Criteria 2000 included 11 learning outcomes (3a-k) ranging from knowledge of mathematics, to an ability to design through to life-long learning. The Washington Accord recognizes substantial equivalency of engineering accreditation among signatory countries. The Washington Accord established 13 learning outcomes in its original version (June 2005) and has 12 learning outcomes in its most recent version (June 2009) [10]. In 2010, the Canadian Engineering Accreditation Board (CEAB) began reviewing and assessing progress towards twelve graduate attributes [11]. There is considerable common language these structures and a common element associated with a requirement for continuous improvement.

The complete transformation to a learning outcomes culture in higher education will take time. The culture shift must ultimately extend from educational developers, to curriculum leaders, to faculty and to our students. The University of Guelph began develop three distinct tools to aid in this culture shift. The tools are Progression Maps, CurricKit, and a Portfolio system. In this paper, the current characteristics of each tool are described followed by a description of their future development. The overall objectives are to convey Guelph's approach and stimulate potential analogous approaches at other schools.

2 Current Status

The current status of the progression maps, CurricKit and Portfolio System will be described in this section.

2.1 Progression Maps

Progression maps have been created to provide a visual representation of curriculum flow, coherence, and balance. The maps provide an effective visual perspective on the balance of courses in each semester and through the entire program. Simple colour coding distinguishes core courses from electives and is used to distinguish courses from different academic disciplines. Over 50 programs at Guelph have been mapped including Guelph's engineering programs.

For several programs this simple visualization has identified a number of opportunities to achieve greater curriculum balance or to unintended structural barriers in the curriculum.

The maps are currently generated manually using an open-source concept mapping software package [12]. Manual creation requires ongoing time commitments to maintain currency. This ongoing time commitment reduces the value in adding greater depth and breadth within the visual maps.

2.2 CurricKit

CurricKit Curriculum Mapping Software was developed as a result of an internal (University of Guelph) need for systematic data collection from faculty and instructor. The data collected from individual courses as to which and how program-level outcomes are fostered and assessed through individual courses. Aggregating and analysing the intended program outcomes as interspersed throughout the curriculum can achieve a more cohesive, coordinated and effective curriculum.

Through the experiences and lessons learned in using CurricKit, it became evident that other institutions may be able to use a similar tool, which takes into account the oft-found university culture that encourages faculty autonomy in and ownership of course design and delivery in aggregating courses for a curriculum perspective.

When combined with other data often collected in many curriculum review processes (e.g. alumni surveys), curriculum committees, faculty, students and others are actively engaged in gaining insight in the intention of the curriculum (outcomes), where and how these outcomes are fostered and assessed, and any

gaps, redundancies and opportunities for curricular enhancement that may exist.

2.3 Portfolio System

A Guelph Engineering Portfolio system was initiated following the NSERC Chairs in Design Engineering development of the White Paper on Design Competencies [13]. The original goal was to support student and program portfolios around design competency guidelines.

A portfolio in its simplest form is a collection of one's work. This collection is reflected on as a personal assessment in order to build a personal story. This personal story can guide future learning development and can be shared. In addition to the obvious student portfolio it is equally valuable to consider a program portfolio.

The current portfolio system permits the collecting of student work and the storage database tracks the learning outcomes associated with each entry.

3 Future Story

The University of Guelph aspires to accelerate its success in achieving learning outcomes and its ability to assess progress. To achieve this goal the University would potentially like to see every program with a mature and intentional curriculum map and every student graduating with a reflective portfolio. Each of these developed within a learning outcomes framework. It is believed that the next generation of the three tools offer important support for the University's aspirations.

The plan is to develop the next generation of the three tools as a set that are interconnected and mutually supportive while at the same time permitting users to use them as three autonomous tools. This later approach permits users to engage in this learning outcomes world from multiple entry points and to start their engagement in a light manner if desired.

The progression maps will serve as a dominant mechanism for users to visualize learning outcomes. The maps will be dynamically produced. They will stay current and specific to each student. The maps will visually convey the curriculum flow of courses and electives. They will equally portray learning outcomes by intent. For a given learning outcome (eg communication) the maps will identify which courses in which semesters contribute to that outcome. A student will be able to visually see their own progression in learning outcomes by semester. The

progression maps dynamic character will be based on a connection to both CurricKit and Portfolio Systems.

CurricKit is the primary structure in which to develop curriculum intentions across the entire program. It is the primary location to develop an understanding of the learning objectives for a particular discipline. What do they really mean? How do we assess? What level do we aspire to?

It is within CurricKit that programs will answer these questions. Guided by effective structures and surveys it will be possible for a program to build discipline specific understanding of each learning outcome. This understanding will contribute to the construction of desired achievement levels within in learning outcome. These levels will be set using any agreed upon learning taxonomy. Finally, the development of assessment protocols will be supported.

The output of CurricKit leads to intention maps that will be visually conveyed as learning outcomes progression maps. It is expected that seeing the intended progression of each learning outcome will lead to some immediate opportunities. The visual learning outcomes intention in the hands of individual educators and students will have a positive impact.

The portfolio system is already fully functional in collecting student artefacts. It supports collection of course work and extracurricular projects. The artefact database includes the learning outcomes associated with that work, a star rating and a mini-reflection.

The next step in the development of the portfolio component is to build the framework for the learning outcomes based reflection and sharing. The system will permit students to develop a story associated with their development of knowledge, skills and values (judgement, creations) under EACH learning outcome. In creating this story, the student accesses their artefacts linked to a learning outcome. They are able to search and/or sort these artefacts by date, by star rating and by their mini-reflections. The system will also scaffold an overall portfolio story by combining each of the individual learning outcome stories. The student will then edit and adapt that scaffolded story.

This reflection and story creation will draw from the portfolio component but it will operate through the progression map visual framework. The combination of these two components will permit students to use the visual tools to plan their elective choices to build a strong learning outcomes portfolio.

It is equally important to develop a program portfolio. A program's achievement of learning outcomes can be viewed as the program as whole. As a whole, it is an aggregate of artefacts across all students. The system is being configured to support this form of program portfolio. The creation of

individual learning outcome stories and overall learning outcome story from an overall program perspective will parallel the student experience.

Equally, or possibly even more importantly, a program portfolio is best captured by the collection of student portfolios. A learning outcome educational framework requires all graduates achieve the minimum for each learning outcome. It is equally important that all graduates have an overall profile that exceeds the simple sum of the minimum requirements.

The University of Guelph is striving to have every program with an established learning outcome intention and that every student graduate with a reflective portfolio. This goal is admirable and represents a transformation of education.

The tools described here in themselves are not sufficient. Educational developers, educators and students need to think learning outcomes. It is expected that the tools will help but it is also necessary for all to participate in workshops and other initiatives in order to make the transition successful.

The future will mean that every Guelph student has planned their individual academic program with the aid of a learning outcome perspective, they will have understood the role each course plays in their learning outcomes development, they will have received feedback from a learning outcomes framework and they will have reflected on their own learning outcomes capabilities. Upon graduation they will have a mature understanding of their own learning outcomes that make them a CEAB engineer, a Guelph engineer and what personal attributes distinguish them as an engineer. They will have a portfolio that articulates their story and provides the supporting evidence for their characteristics.

The future will equally mean that every Guelph engineering program has an intentional curriculum to deliver learning outcomes, that each program will have provided meaning specific to their discipline for each learning outcomes, that all educators understand their role in learning outcomes and that each program has developed a reflective portfolio. It is this reflective portfolio that will be the driver for continuous improvement.

Learning outcomes are an important element of the future in engineering education. Intentional mapping, reflective portfolios and visualization tools will be aiding Guelph's the transition to this pedagogical approach. Other institutions are encouraged to consider the role these tools could play in their work towards a learning outcomes framework.

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