THREE BIRDS, ONE STONE: A PEDAGOGY AND ACCREDITATION DRIVEN REDESIGN OF CO-OP WORK TERM REQUIREMENTS

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Abstract –This paper describes a proposed redesign of the instruction and assessment of the Co-operative (Co-op) Education (or work term) components of the University of Victoria Engineering program. The redesign ensures instruction and assessment of the higher-level Graduate Attributes (GAs), such as individual and teamwork, communication skills, professionalism, impact on society, ethics and equity, economics and project management, and life-long learning, that may not be included in all of the technical courses in a traditional Engineering curriculum. Concurrently, the redesign includes a renewed emphasis on improving the technical writing competency of graduating engineers by: ‘laddering’ student technical writing development; introduction a new grading scheme; increased timeframes for report revisions; and, finally, reducing the number of pedagogically ineffective reports required to graduate.

Keywords: Graduate attributes, Co-op Reports, Technical writing, Accreditation, Work term.

1. INTRODUCTION

Co-operative Education (Co-op) is an integrated and mandatory part of all undergraduate engineering programs at the University of Victoria (UVic). Through the completion of at least 16 months of paid, relevant work placements, students gain valuable real-world experience and help offset the cost of their educations.

Co-op work terms also presumably provide an opportunity for our students to develop in the Graduate Attributes, especially the higher-level attributes, that may not be incorporated into technical courses. However, as discussed in Harsh et al [4], simply having on-the-job experiences may not necessarily lead to students acquiring related attributes.

The programs at UVic are also interested in developing more sophisticated tools to assess student learning while on work term, beyond the student and employer surveys currently in use [3].

Other challenges related to the Co-op program have also been identified at UVic. Student engagement with and performance on work term reports needs to be improved.

Additionally, final year technical writing course does not seem to be achieving its intended outcome of preparing students to create workplace-quality technical recommendation reports.

To address these three related issues, a team at UVic is proposing a redesign of Co-op work term requirements. In this paper, we further develop the motivation for this redesign, discuss the work and consultations that have led to the current proposal, and describe the proposed redesign in detail. Finally, we lay out the issues that still need to be resolved before the redesign can happen.

UVic is certainly not the only school that is looking to increase the instruction and assessment of higher level attributes, or that wants to further develop its Co-op program. Hopefully, this paper will serve as information and inspiration for other schools who are considering similar changes.

2. MOTIVATION

Three related issues provide motivation for the proposed redesign: increasing instruction and assessment of higher-level GAs; enhancing student engagement with and performance on work term reports; and achieving intended outcomes of technical recommendation report course. These three aspects are discussed in more detail below.

2.1. Higher-level GAs

Like all accredited engineering schools across Canada, the Faculty of Engineering at UVic includes instruction and assessment of all GAs in its curriculum. However, also like all schools, our programs are always looking for way to increase the amount of instruction our students receive in the higher-level GAs, and the quality and quantity of assessment data related to these attributes. Co-op work term placements seem to have an obvious connection to GAs #8 – 12: professionalism, the impact of engineering, ethics and equity, economics and project management, and life-long learning. A key motivation for the proposed redesign is to add explicit instruction in these attributes to the work term experience, and to gather usable assessment data to measure students’ development in these areas.

2.2. Work Term Reports

Currently, a student in the UVic Engineering Co-op program is required to write a concluding technical report for each of their four mandatory co-op experiences. When reviewing the impact and success of the co-op work term reports, it is apparent that many students do not fully engage with the experience, and provide reports with inadequate subject reasoning and technical detail; thus limiting their pedagogical value.

This limited engagement and value, combined with the significant writing and marking workloads for the student and Co-op department respectively, hampers the ability of students and Co-op department to focus on more impactful tasks.

2.3. Technical Recommendation Report

As a graduation requirement, engineering students in some programs are also required to enroll in a major technical report class, which is completed by students while on work term. This requirement was initially introduced to comply with AU-related accreditation requirements. Unfortunately, the course suffers from the same issue as the co-op work term reports; students do not engage with the course, and produce reports of inferior quality. Additional issues in the course include an outdated marking rubric, limited timeframes to work with students to improve submissions (the course is typically delivered in the final term of the degree), and it has the perception of significantly increasing workload without achieving skill development outcomes.

3. METHODOLOGY

The development of the proposed redesign presented here began in April 2017. Initially, ideas were discussed between the chair of the Mechanical Engineering program and the faculty's Accreditation Analyst. As the scope of the project became apparent, the Associate Dean Undergraduate Programs and the Program Manager of the Engineering and Computer Science Co-op and Career program also joined the discussion. In June 2017, an adjunct professor was hired as a consultant to oversee the process.

A review of similar projects within the Engineering education community was carried out to identify best practices and lessons learned. After a survey of the GAPNet community [2] and a literature search, the WATPD-Engineering program at the University of Waterloo [6], the Engineering Work Term Curriculum Pilot Study at Dalhousie University [7] and the law and ethics modules of the capstone design course at the University of Guelph (J. Donald, personal communication, 13 July 2017) were identified as particularly relevant to our situation. The consultant communicated with

representatives at each of these schools to further discuss these projects.

Projects outside the engineering education community were also explored. The Mitacs Training workshops [5] in Communications, Teamwork and Project Management were identified as a potential resource to incorporate or emulate. The consultant communicated with Camosun College, about developments in their Co-op program and on-line course delivery options; UVic's Peter B. Gustavson School of Business, about their reflective learning exercises, and the successes and failures of their on-line course delivery system; and Engineers and Geoscientists of British Columbia (EGBC), to explore the parallels between the GAs and the EGBC competencies [1].

The Co-op program is an important stakeholder in this project. A careful review of the Canadian Association for Cooperative Education's accreditation requirements was performed to ensure that the proposed redesign would not affect the accreditation of the Co-op program.

Finally, in-depth discussions were held between the Associate Dean, the Co-op Program Manager, and the Admissions/Advising Officer of the Faculty of Engineering to explore the impact of the proposed redesign on transfer credit, academic standing, promotion and graduation. The university's Associate Registrar Undergraduate Admissions, Records, Curriculum and Calendar was also consulted about potential implications of the project.

As these consultations were carried out, the proposed redesign was developed and refined. A key milestone was reached in November/December 2017 when the proposal was presented to the department chairs and program directors of the other 5 engineering programs at UVic. All were enthusiastic about the opportunities presented and committed to support the project. They also provided valuable feedback that further refined the proposal.

Finally, in March 2018, the Dean of the Faculty of Engineering provided his feedback. On the basis of this input, the team developed the proposal presented here.

4. PROPOSED SOLUTION

The proposed redesign involves introducing learning content focused on higher-level GAs and a new work term report format. Under the redesign, work term requirements will now incorporate three sections: a review of the work performed during the term; a lifelong learning and competencies section; and a section dedicated to GA components. Figure 1 gives an overview of the requirements in each of the four mandatory work terms.

The details within each section are still in the proposal stage, and will be confirmed prior to implementation.

4.1. Work Term Review

In the work term review section, students will be required to provide an overview of the work performed during the current work term. This will include research on the company's business sector, the function of the student's current role, and future career options with the sector. Additionally, student are encouraged to 'Interview a Colleague' at work to better inform their perspectives of the company and the greater business sector.

The requirements for the work term review will be sequentially 'laddered' to better prepare students for the Technical Engineering Recommendation Report in WT #3. The work term review will be less than 1 page in length and graded by Co-op coordinators.

Work Term #1		Work Term #2	
Review of WT		Review of WT	
Lifelong learning & Competencies		Lifelong learning & Competencies	
Multiple Choice Q&A	#8: Professionalism	Multiple Choice Q&A	#9: Impact on Society & Environment #10: Ethics and Equity
Reflective Thinking		Reflective Thinking	
Work Term #3		Work Term #4	
Review of WT		Review of WT	
Lifelong learning & Competencies		Lifelong learning & Competencies	
Written Report	Technical Engineering Recommendation Report	Multiple Choice Q&A	#11: Economics & Project Management
		Reflective Thinking	

Figure 1: Proposed revised work term deliverables, graduate attribute foci, and response format.

4.2. Lifelong Learning and Competencies

As part of the current work term requirements, all Co-op students at UVic are required to complete a competency assessment. At the beginning of each Co-op term, students self-assess themselves in 10 core competencies, defined by UVic's Co-operative Education Program and Career Services Office; they are traits that every UVic Co-op student should be expected to develop. Students then work with their employers to choose at least three competencies of focus during the work term. In the middle and again at the end of the work term, the student self-assesses their own progress in the three chosen competencies. After the student has completed their assessments, an automatically generated email is sent to their employer. The employer accesses and reads the students' self-assessments, and adds their own assessments. Co-op coordinators discuss the initial and mid-term assessment with the student and their employer during the work-site visit, and all three

assessments with the student before they apply to their next work term.

This process has obvious ties to GA #12, life-long learning. To highlight and strengthen these ties, the competency assessment process will be expanded with requirements for each student to identify personal knowledge gaps, develop a career plan and learning plan that includes activities to expand their knowledge in identified fields. Students will be required to re-assess their development against their learning plan at the middle and end of each work term to relate their learning plans to the plans they developed in previous terms. The Co-op department will maintain responsibility for student learning plans.

4.3. Graduate Attribute Learning and Reflective Thinking

The third section of the new work term requirements will focus on one or two higher-level GAs in each of work terms #1, 2 and 4. Content will be delivered on-line through UVic's Learning Management System (LMS), and will include readings, case studies and assessment. Assessment will be based on multiple choice questions and answers, and longer form reflective thinking exercises. The multiple choice portion will feature mandatory questions (to test competence in the GA) but also randomly chosen questions (to ensure individual testing).

GA-specific readings, content and questions will be bundled into online modules. Modules will be designed by Subject Matter Experts and require an average student time commitment of 4-6hrs/module. Modules will only become available once the previous module is completed – this will allow student to progress at an accelerated pace if they so desire, but not to fall behind. The online format supports report generation and creating student performance metrics.

The reflective thinking and writing portion of this section will be based on provided case studies, professional practice principles and techniques developed in the course-based curriculum. Reflective writing content will be delivered within the same LMS and will be marked by Co-op coordinators. In each term, students will be required to submit 2 – 4 reflective writing pieces of ½ page each.

4.4. Technical Engineering Recommendation Report

During work term #3, students will not complete any GA-specific content but rather will be required to write a technical engineering recommendation report. This report will demonstrate the student's ability to identify problems/opportunities, research the relevant literature, formulate and analyse possible solutions, and deliver a final recommendation; all captured in a coherent and technically explicit engineering recommendation report.

Students will be introduced the format of the technical engineer recommendation report and given opportunities to practice this form of writing through the first section (the Work Term Review reports) of work terms #1 and 2. Placing the technical report requirement in work term #3 allows students and engineering faculty markers to ensure the report is of sufficient quality to receive a passing grade without endangering any student's imminent graduation. If the student provides an inferior report, they will be provided with the opportunity to write a supplementary report prior to receiving a failing grade.

Marking will be conducted by Engineering faculty members. The marking rubric will be updated, and training provided for the markers.

The current technical report course will be removed from the curriculum.

4.5 Personnel Requirement and Estimated Budget

Based on discussions with other universities and colleges, and internal UVic experts, the project development team has projected personnel and financial requirements to develop the necessary content, implement the necessary changes, and successfully manage this new project for long-term success.

As an initial estimate, the up-front development costs for Subject Matter Experts (SME) and implementation support will be ~ \$20,000/course.

On-going personnel requirements include a program manager/administrator, IT support, SME stipends and teaching assistants. It is estimated that, on a per student basis, these on-going costs will be ~ \$106/student per annum. This includes the design/redevelopment of one work term GA-specific module per annum.

In order to achieve a low-cost but sustainable program, the Engineering faculties and Engineering Co-Op Department will be providing ~\$100/student in in-kind faculty and staff support.

5. DISCUSSION

Before the proposed redesign can be implemented, a number of outstanding issues need to be resolved.

First is the question of grading. In order to encourage the engagement of students with the new requirements, the work terms will be given a numeric grade and recorded on their transcripts. This is a change from the current practice of assigning only a complete/incomplete grade for work terms. However, we do not wish to change the fact that work term grades do not factor into a student's academic standing or graduation GPA. Assigning a numeric grade that is not used in GPA calculations will require consultation with and approval from the Senate committees.

Another important step that needs to be taken is consultation with students and employers. The feedback from these stakeholders is essential, and will likely result in further refinements.

The proposed redesign marks a major change to Engineering programs at UVic. It will be important to measure the effect of this change: how effectively has the redesign addressed the challenges that motivated it? Methods for assessing the impact of this change will be developed.

Implementation details of how the new work term requirements also remain to be determined. Will all four new sets of requirements be enacted at once, or is a phased-in approach better? What will students who are mid-way through their programs be required to do? It may be necessary to run the new requirements in parallel with the old requirements for a few years; this of course has implications for the workload of the Co-op office.

Once the details of implementation are determined, a communication and education plan will to be developed. Students and instructors need to understand why the requirements have changed, and how these will enhance learning and future career prospects. This will also provide a chance to increase student and instructor awareness of and engagement with the Graduate Attributes.

Finally, funding must be secured. Some potential grants have been identified, both internally through the university's Learning and Teaching Centre, and externally. These grants could help in the development of the redesign, but for the program to continue and thrive, continuing funding is a must. Hopefully, the clear benefits that this redesign could provide will provide sufficient motivation for that funding to be found.

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