DEVELOPING AN ONLINE PROFESSIONAL DEVELOPMENT CURRICULUM FOR STUDENTS ON INTERNSHIP

Robyn Paul, Dr. Arin Sen, and Dr. Bill Rosehart

Schulich School of Engineering, University of Calgary

ABSTRACT

Engineering internships provide students with an opportunity to apply their knowledge in real world settings. Internship students also gain firsthand insight to the value of developing their personal and interpersonal skills. This integrated learning experience is an important element of CDIO. This paper describes the development and implementation of an engineering professional development internship pilot course. First, the attributes most beneficial to be developed on internship were determined. Next, these attributes were distributed over a year-long internship based level of experience and applicability. Lastly, course modules were developed, including module content and assignment for each topic. The first cohort of students are two thirds into the pilot program. Their feedback and insights on the effectiveness of the course are shared. The results discussed in this paper will be useful to institutions looking to develop or improve their engineering internship or work term programs. The curriculum design has been modeled to ensure an integrated learning experience while students apply their disciplinary knowledge during a professional work experience.

KEYWORDS

Cooperative Education, Engineering Internship, Professional Development, Online Learning, Standards: 7, 8.

INTRODUCTION

Year-long engineering work terms (internships) provide students with an opportunity to apply their knowledge in real world settings. Internship students gain firsthand insight to the value of developing their personal and interpersonal skills. This integrated learning experience is an important element of CDIO, and internships provide an excellent opportunity for students to conceive, design, implement, and operate products, processes and systems (Crawley, Malmqvist, Östlund, & Brodeur, 2011, p.297).

Interns are typically required to maintain a full-time student status. Their home institution therefore, has the responsibility to ensure the successful acquisition of learning outcomes, independent of their internship experience. Institutions must take on an active role in the professional development of students on internship in order to enhance their experience and learning. This paper describes the development and implementation of an internship course focused on engineering professional development.

BACKGROUND

The growth of cooperative education in the first half of the 20th century was motivated by the needs of industry to better prepare engineers (Haddara & Skanes, 2007). And this need still exists today as engineering education moves towards an outcomes based approach focused on both technical and professional skills. These professional skills are often difficult to teach in a classroom setting, and internship provides an excellent opportunity to develop these attributes in undergraduate engineering students.

Engineering Internship

Internships can be defined as "structured educational strategies that integrate classroom learning with practice work experience through productive work placements in fields related to the students' career goals" (Fifolt & Searby, 2010). The benefits of internships have been highly documented. Haddara & Skanes (2007) provide a thorough review of studies which show the positive benefits for new graduates, including increased starting salaries, higher levels of responsibilities, improved confidence (particularly in females), increased career satisfaction, as well as benefits to the employer and the institution (Haddara & Skanes, 2007).

Internship experiences provide students with opportunities to practice their skills in an authentic engineering environment. It has been shown that the effectiveness of an internship experience can be improved with mentoring and support during the experience (Fifolt & Searby, 2010). The transition from the classroom to the workplace is challenging, and providing students with feedback and guidance can assist in this transition.

Engineering expertise is gained through exposure to multiple opportunities to practice skills on authentic tasks that require an integrated approach (Litzinger, Lattuca, Hadgraft, & Newstetter, 2014). Internship provides a venue where students can engage in engineering tasks in a real world setting. However, expertise is most effectively developed when students engage in "deliberate practice," where they practice with the intention to improve their skills (Litzinger et. al., 2014). A successful internship program should therefore encourage a practice of self-reflection and self-directed learning.

Online Learning

Online education has become a prominent field of interest due to the accessibility and flexibility the online environment provides. As outlined by Bourne, Harris, & Mayadas (2005), there are three important elements to consider when teaching engineering in an online environment: quality, scale and breadth. The online environment provides an excellent venue for internship students, as it easily scales to different locations and varied time commitments. The quality and breadth of an online professional development course for internship must also be considered.

MOTIVATIONS

At the Schulich School of Engineering, University of Calgary, approximately 400 students (about 75% participation rate) partake in an internship program between their third and fourth year of studies. Student internships can span over two 6 – or 8-month positions, one 12-

month position, or one 16-month position. Each experience is unique and provides the students with valuable insight into the engineering workplace.

While on internship, participants must maintain full-time student status with the University. This is accomplished by having the students register in a sequential series of internship-related courses: INTE 513.01, INTE 513.02, and INTE 513.03. Each course spans one term in length (four months). For students doing a 16-month internship, although there is a final term course (INTE 513.04), there are no requirements or fees associated with this course.

Prior to May 2015, students were required to write a report for each course while they were on internship. The three reports, which were increasingly complex in their requirements, had the following topics: 1) Roles, Responsibilities, and Goals; 2) Accomplishments, and Business/Industry Overview; 3) Comprehensive Engineering Report.

Each student was paired with a faculty member at the Schulich School of Engineering who served as a mentor. The faculty mentor was responsible for reviewing and assessing the reports submitted by the student, and provide feedback regarding the content and structure of the report. However, there were a number of concerns associated with this approach. Firstly, any confidential content was either removed from the report, or was blacked out, which was often the majority of the report. Secondly, the feedback received from the faculty mentor was often limited. The time commitment required to provide adequate feedback was challenging to fit into their already busy schedules. Some faculty mentors provided valuable feedback, whereas others did not make the time to provide significant feedback. Faculty also felt the reports had limited linkage to meaningful learning outcomes. The end result of this process was undesirable, in that students saw little value in generating these reports. For this reason, the academic internship curriculum was redeveloped and a Pilot program was launched Spring 2015.

DESIGN AND DEVELOPMENT

The environment of an internship course is different than traditional academic courses. Internship students have a wide variety of experiences including different locations (local, national, international), different situations (office work, field work), different skillsets required (technical design, project management, operations), and different levels of responsibility (small companies compared to large companies). For this reason, the course content had to be adaptable and flexible to each student's personal experience.

Course Goals

Before designing the course, it was important to consider what overarching goals and learning outcomes the redeveloped internship courses would provide. There were four target goals for the program:

1. Develop students' self-awareness skills in order to encourage students to reflect on their learning experience while on internship.
2. Provide students with skills not normally taught in the classroom that complement their work experiences.
3. Design a curriculum that provides high value content for low time commitment.
4. Provide valuable, personalized feedback to help students become progressively more effective and reflective in their work.

Each course requirement that the students were given was compared against these course goals to ensure we were developing a high quality program.

List of Skills and Attributes

The first step in the internship curriculum redevelopment process was to consult with engineering leaders and experts at the University to collect an extensive list of professional skills beneficial to cultivate in engineering internship students. The initial list of skills included almost 100 different topics that were categorized into nine areas of development:
- Communication
- Design
- Teamwork and Leadership
- Project Management and Economics
- Impact of Engineering on Society and Environment
- Ethics and Equity
- Ethics in Engineering Practice
- Professionalism at Work
- Personal Development and Wellness

These categories, and the associated lists of attributes were presented for input to the five engineering department heads and other stakeholders. It was important to not only consider which skills were important to include within an internship experience, but also when during the work-term a particular skill would be most beneficial. For example, a student early in their internship may have had little interaction with leaders in their organization, therefore leadership would be a topic appropriate for later. After this interactive discussion process was completed, the specific topics within these categories were chosen for the first INTE 513.01 pilot course.

Course Design

During a four-month work term, six topics were chosen and developed as online modules. Six was thought to be an appropriate quantity considering the typical responsibilities a student would already have associated with their internship job. The time commitment for each module was between 1-2 hours, and the assignment due dates were once every two weeks.

Module Streams

Six module streams were used as a framework for the INTE 513 pilot program, as depicted in Figure 1. The flow across each module stream allowed students to build on the topic with each term. However, it was also important to ensure there was flow across one course, with a clear connection for students between each module.

Assignments

All assignments were qualitative and included two elements. Firstly, students answered simple questions throughout the module in order to confirm their understanding and ensure they were actively engaged in the material that had been provided to them. These questions were checked for completion, however the answers were not reviewed in detail.

Figure 1. Overview of INTE 513 Pilot Module Streams.

Next, each module included reflective questions which asked students to apply the module content to their own work experience and reflect. For example, a module on *Engineer's Role and Organization Value* asked the students the following reflective question:

> How do your day-to-day activities as an intern follow your organization's mission and vision? Although the project/tasks may not have a direct impact, how do they fit within the organization as a whole? Consider how your tasks may contribute in very small ways towards the mission and vision.

The assignment questions were structured to ensure that students in a variety of different workplace settings would be able to engage in meaningful reflection. The questions were left open-ended so that students could reflect in a way that was useful to their own personal situation, while still being specific enough to achieve the module's learning objectives.

Online Format

An online format was chosen to provide flexibility for the students. Especially since many students are working in internship positions that are not local, it was important that there was no in-class requirement for the course. Some students also had limited access to the internet due to business trips, or field work in remote areas. For this reason, assignment due dates were always flexible, as long as students provided the instructor with sufficient notice for requesting an extension. Planning ahead and being aware of time conflicts is an important skill for students in the workplace.

Providing Written Feedback

One of the goals of the new internship courses are to provide students with valuable feedback. Graduate students were hired as teaching assistants (TAs) to mark assignments and provide personalized feedback and career insights for each student. The hiring process included an application and a formal interview.

TAs were hired based on three criteria: 1) Engineering industry experience; 2) Expressed an interest in mentoring undergraduate students to improve their professional skills; 3) Strong written English skills, as all communication with the students would be online. During the hiring process, the diversity of the group of TAs was also considered. Each student would hear feedback from different TAs during one term, and it would be beneficial for them to hear from diverse perspectives.

RESULTS – STUDENT FEEDBACK

The first cohort of students using this new format started internship in May 2015. This group included 277 students, and they have completed two thirds of the program, courses INTE 513.01 and INTE 513.02. The second cohort of students started in September 2015. This group included 83 students and they have completed the first term, course INTE 513.01.

The initial response to this new course structure has been mixed. Students enjoy the module content, appreciate the personalized feedback, and understand how the material not only helps them in their current internship position, but also how it is related to their future success as professional engineers. However, the students are aware they are the pilot group, and they also provided comments in order to help improve the courses going forward.

Feedback was collected at the end of each term. For each module, students were asked ten questions rated on a 5-point Likert-scale from strongly disagree to strongly agree on the content, assignments, and overall impressions of the course (see Table 1 for list of questions). The last few questions on the survey asked the students to rate the six modules based on the most interesting, the most valuable, and the largest time commitment. Open textboxes were provided throughout the survey for any further comments the students wished to include.

Table 1. Summary of the End-of-Term Survey Feedback Questions
(rated on a 5-point Likert scale of strongly disagree to strongly agree).

End-of-Term Survey Feedback Questions (for each Module)

1. Please rate the following based on the Module **theory**.
    a) The theory content was new information for me.
    b) The theory was an area I was interested to learn about.
    c) The theory was presented in an engaging way for me to learn.

2. Please rate the following based on the Module **assignment**.
    a) The assignment had clear requirements.
    b) The assignment improved my understanding of the content.
    c) The assignment was enjoyable to complete.
    d) My assignment grade was reflective of the work I submitted.
    e) The written feedback I received was beneficial.

3. Please rate the following based on the Module **overall.**
    a) This Module improved my professional skills.
    b) I can apply the skills learned to my engineering career.

Term 1 Results – INTE 513.01 Feedback

The following feedback is from the 83 students who started in September 2015 and have completed the first course, INTE 513.01. The quantitative results from the survey are provided in Figure 2. On average, 13% of students Strongly Agreed and 43% Agreed with the statements from Table 1. There were still 5% of students who Strongly Disagreed, 10% who Disagreed, and 29% who felt Neutral about the statements.
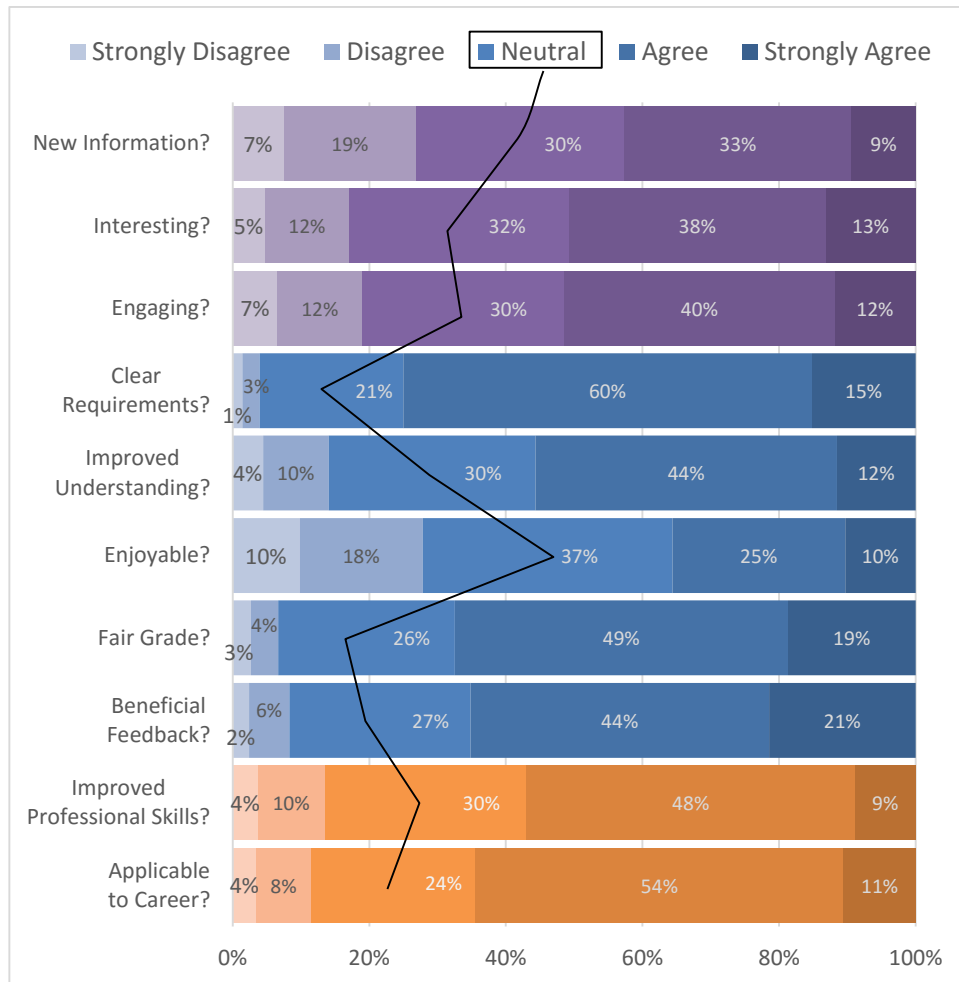

Figure 2. Results of feedback survey questions from Table 1 for the first term, including Module Theory (purple), Module Assignment (blue) and Module Overall (orange).

Looking more closely at the results in Figure 2, the areas student provided the strong positive feedback was in *clear assignment requirements*, *fair grades*, and *beneficial feedback* on the assignments. However, the area where students showed the strongest negative feedback was in how *enjoyable* they felt assignments were.

The students' written feedback comments were also analyzed. The positive feedback generally included comments on the fact that the topic was beneficial, informative, and applicable to the internship experience. Positive comments also mentioned the value that was provided in the TA feedback. Some examples include:

- *"I had fun completing [this] module. It was engaging and informative."*
- *"I really thought the feedback I received about the [assignment] that I had was the most useful part of this module."*
- *"This was an interesting module. Probably the most interesting out of the bunch."*
- *"The course was well-designed. For the most part, it was applicable to the internship. It does prepare interns for the real world, to a certain extent. Assignments are clear and marking does not take too long."*
- *"I much preferred doing these modules to writing reports. I feel like the modules were easier to manage, and also pushed me to talk to my coworkers and learn."*

The student surveys were anonymous and the students were encouraged to provide honest feedback. They were aware this was a pilot year for the program, and that we were seeking feedback on areas of improvement. The negative comments from the students tended to focus on the content being boring or knowledge that the students already possessed. There were also many students who mentioned the time commitment required to be too high. Some examples include:

- *"Rather quite boring and rather obvious knowledge"*
- *"The INTE course takes up too much of the student's time, and it is visibly obvious that each and every module can be shortened and made more simpler."*
- *"A lot of materials were covered within the company...And it's kind of boring to do them all over again."*
- *"Honestly, this takes too much time."*

Term 2 – INTE 513.02 Feedback

The term 2 feedback results are from the 287 students who started their internship in May 2015, and have completed both the first and second course. The quantitative results from the survey are specific to the second term course, INTE 513.02, and are provided in Figure 3. Unfortunately, this group of students was not surveyed on the first course, INTE 513.01.

On average, 15% of students Strongly Agreed and 42% Agreed with the Table 1 statements. There were still 8% of students who Strongly Disagreed, 11% who Disagreed, and 23% who felt Neutral about the statements. Compared to the term 1 results, the students had more extreme opinions, with higher percentages Strongly Agreeing and Strongly Disagree, and 5% less students giving a Neutral response to the questions.

The results in Figure 3 align closely with those from Figure 2, where students felt strongly positive about the *clear assignment requirements* and *fair grades*, though *beneficial feedback* was not as highly rated as in term 1. The strongest negative feedback in the second term was again how *enjoyable* the students felt the assignments were.

After two terms of completing the updated INTE 513 program, students provided lengthy and passionate responses in the written comments. Overall, the 272 students wrote a total of 384 comments, averaging over 35 words each. The comments provide excellent insight into the successes and challenges of the new INTE 513 program.
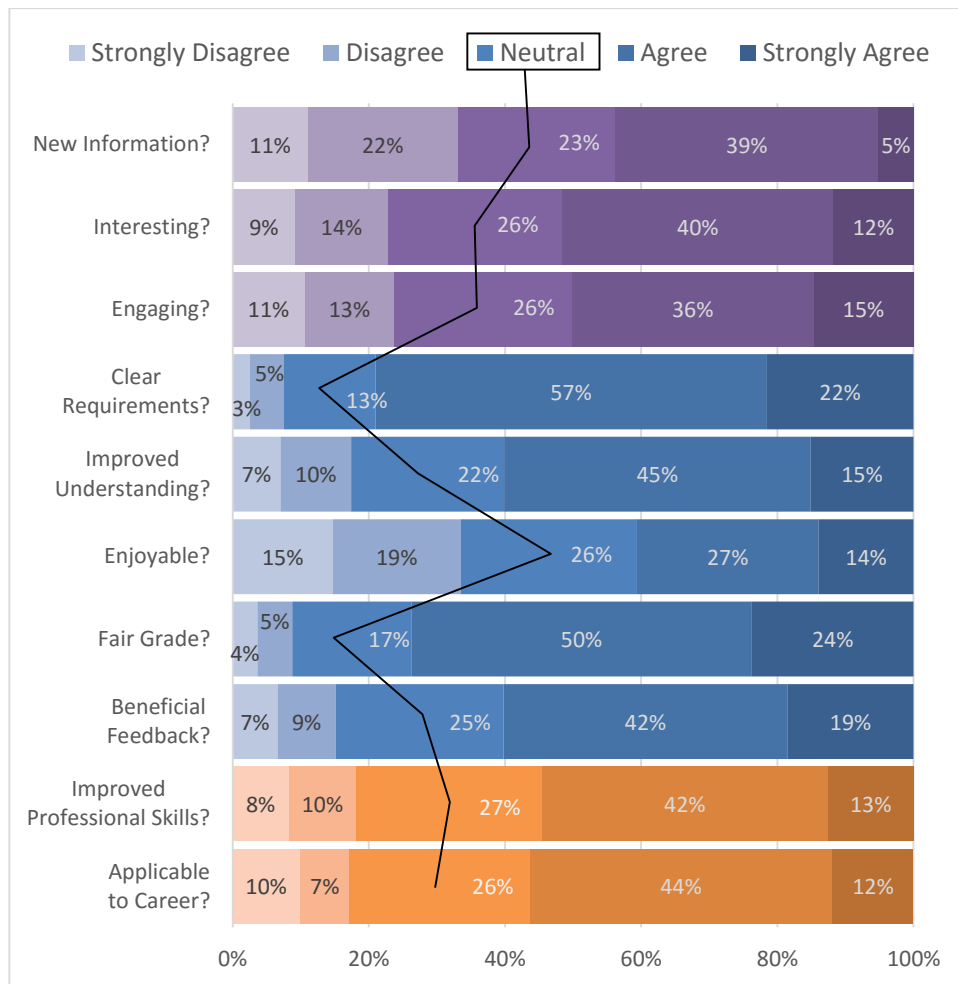
Figure 3. Results of feedback survey questions from Table 1 for the second term, including Module Theory (purple), Module Assignment (blue) and Module Overall (orange).

Most of the positive comments focused on the assignments which the students found most useful, excellent written feedback from the TAs, and elements of the INTE 513 program which they enjoy. Some examples include:

- *"The feedback I received from this assignment was the most useful to date. I feel like it was very effective and encouraged me to take more initiative in my work."*
- *"I enjoyed this assignment and found it useful and relevant to work and internship."*
- *"As someone who is not good with conflict this was the only module of the bunch that I felt I would be able to apply to career."*
- *"I always value written feedback more useful than a number. This semester's feedback was more useful than previous."*
- *"I really liked the course. I like these modules for 2 reasons: - They inform me about little areas I can work on. - They take little time."*
- *"Great course, really liked the small learnings from the modules"*

Again, the student surveys were anonymous and the students were encouraged to provide honest feedback. The comments on areas for improvement tended to focus on the content

being areas the students were already familiar with, too high of a time commitment, and lack of engagement during the modules. Some examples include:

- *"The theory content was something we have heard hundreds of times before."*
- "*For the most part, the information was not new and I felt like I was writing things simply in order to get a grade."*
- *"All the assignments should be shorter. Take way too long."*
- *"I marked "Disagree" for the module being enjoyable to complete, because it is a little bit boring to answer questions off of a PowerPoint you are reading"*

DISCUSSION

The pilot implementation of an updated internship course for professional development has been able to provide students with valuable skills. The student feedback has been positive, with the majority of students expressing agreement to statements on the value and applicability of the topics. However, as this was a pilot project, there are still many areas for improvement.

Sustaining the Successes

It is evident that students value high quality, individualized written comments and feedback. Many students expressed their gratitude to the TAs for the comments provided and the perspective they were able to provide. It will be important to maintain this aspect of the program, and to ensure there is a higher degree of consistency across the TA comments.

When students are interested in a topic area, they are motivated and engaged to participate in that module. Almost every single module had a comment "excellent, very interesting" as well as "boring module". This shows that the content itself may not be the variable, but rather the students' intrinsic motivation and desire to gain skills in that area. To harness this, the updated version of the internship programs will include an element of choice where students will be required to plan their own professional development journey.

Lessons Learned

During the pilot project, the most common negative feedback was that the questions were not applicable to their internship experience. It is challenging to develop a program which is flexible and applicable to 400+ students in 400+ different engineering internships. Although we succeeded in some respects, it is evident that the assignments require refinement. The assignment questions will need to be adjusted to be more adaptable and applicable to a wide variety of situations to encourage self-awareness and self-reflection in the students. Also, rather than requiring students to complete specific modules, we will introduce an element of choice so that students are required to plan and justify their own professional development journey. Both of these changes will also hopefully help to increase the students' enjoyment of completing modules.

The next most common piece of feedback, particularly for INTE 513.02, was that the modules took too much time to complete. The goal of the course was to provide high value for low time commitment. It is evident that as students' progress through their internship experience, their work responsibilities increase and they have less time to complete homework assignments. Therefore, we will be implementing a 6-5-4 model, where the number of modules required in each subsequent course decreases as the students' work responsibilities increase.

Although the course is a Credit / No Credit course, students were given grades on their assignments. However, this meant that they read their feedback seeking to understand the reason for their grade, rather than reflecting on the comments provided by the TA. In the future iteration of this course, the grading procedures will be reevaluated to ensure they are valuable for the students. It will also be important to consider more consistent methods to mark qualitative assignments.

Next Steps

As already discussed, the next iteration of the INTE 513 program will include: 1) open-ended assignment questions that are adaptable to individual situations and encourage self-reflection; 2) an element of choice where students must plan and justify their own professional development journey; 3) reduction in course requirements for each subsequent course; and 4) improved consistency in the marking methods.

Additionally, we will seek feedback on the updated internship courses from industry representatives. During the pilot phase, industry was consulted and provided us with some initial input, however we will be setting up a formal industry committee in order to further develop and refine the content provided in the program.

Lastly, although Figure 1 illustrates continuity across the module topics both vertically (during a course) and horizontally (across courses), there is room for improvement. Specifically, the continuity across the modules vertically within a course was limited. Students felt after completing one module that there was no connection to the next module requirements. In order to improve this, we will be introducing an element of reflection on the previous topic at the beginning of each new topic.

CONCLUSIONS

The design and implementation of the internship pilot program has been a success so far. Students have expressed gratitude to the redevelopment of the program, and have provided suggested areas for improvement. It will be important to maintain a model of continuous improvement for this course as it is developed and refined.

REFERENCES

Bourne, J., Harris, D., & Mayadas, F. (2005). Online Engineering Education: Learning Anywhere, Anytime. Olin College of Engineering Faculty Publications. http://digitalcommons.olin.edu/facpub_2005/1

Crawley, E. F., Malmqvist, J., Östlund, S., Brodeur, D. R., & Edström, K. (2014). Rethinking Engineering Education: The CDIO Approach (2nd Ed.). Springer International Publishing.

Fifolt, M., & Searby, L. (2010). Mentoring in Cooperative Education and Internships: Preparing Protégés for STEM Professions. Journal of STEM Education, 11(1&2).

Haddara, M., and Skanes, H. (2007). A reflection on cooperative education: from experience to experiential learning. Asia-Pacific Journal of Cooperative Education, 8(1).

Litzinger, T., Lattuca, L., Hadgraft, R., & Newstetter, W. (2011). Engineering education and the development of expertise. Journal of Engineering Education, 100(1), 123–150.

BIOGRAPHICAL INFORMATION

Robyn Paul is a Masters' of Science candidate and Manager of Strategic Planning at the Schulich School of Engineering at the University of Calgary. Her research focuses on the impact that teaching engineers leadership skills has on their early career success. She is also a sessional instructor and is involved with initiatives to collaborate across the University to increase the conversation around engineering education.

Dr. Arindom Sen is an associate professor and Associate Dean (Student Professional Development) in the Schulich School of Engineering. His primary research focus is in the area of bioprocess development and optimization. He is also developing new opportunities to enable engineering students to gain professional skills.

Dr. Bill Rosehart is a professor and Dean in the Schulich School of Engineering at the University of Calgary. His research focus on optimal planning and operation of electrical energy system under uncertainty, along with research in the area of engineering education.

Corresponding author

Robyn Paul
Department of Civil Engineering
Schulich School of Engineering
University of Calgary
2500 University Drive NW
Calgary, Alberta, Canada, T2N 1N4
1-403-220-4816
rmpaul@ucalgary.ca