

# **IMPLEMENTING ACTIVE LEARNING IN FIRST YEAR ENGINEERING – A LEADERSHIP PERSPECTIVE**

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## **ABSTRACT**

In Fall 2021, the delivery of first year engineering at the University of Calgary was changed to blended (or “flipped”) delivery mode, with a focus on studio-based active learning experiences in the in-person component of every course (CDIO Standard 8). In this paper, we offer the leadership perspective on what was required to accomplish the complete overhaul of the first year delivery. Lessons learned from our first year are summarized. Recommendations for future iterations of the delivery method are described.

## **KEYWORDS**

Active Learning, Blended Learning, First-Year, Leadership, Standard 8

## **BACKGROUND – WHY CHANGE OUR DELIVERY MODE?**

The common first-year engineering curriculum is comprised of 10-technical courses: 5 engineering, 1 chemistry, 1 physics, 3 math. In the past (pre-pandemic), these courses were delivered in a fairly traditional manner. Each course included 3-4 hours per week of lecture time, 1-2 hours per week of tutorial and some courses have a 2-3 hour weekly or bi-weekly lab session. Prior to 2021, our first-year cohort consisted of approximately 800 students enrolled in 4 blocks of approximately 200 students. In Fall 2021, we expanded our first-year enrolment to 1000 students. With the conventional model, this would mean five separate instructors delivering the same lecture material to separate large classes. This presented continued challenges around ensuring consistent delivery of the material across lecture sections. In addition, with the large class sizes, students often report feeling quite anonymous and disconnected from their community.

The decision was made to change the delivery method in all ten courses to a blended delivery mode, with lecture content delivered via lecture videos, and all in-person time converted to active learning sessions. The benefits of flipped delivery has been discussed often in the past years (Lo and Hew, 2019). In our institution, there were several reasons why it was particularly appealing at this time.

### ***Utilize Online Content***

During the emergency switch to remote delivery during the pandemic (March 2020 onwards), instructors were forced to create online content. For many of us, this included creating lecture

videos and developing our skills using online Learning Management Systems for communicating with students, managing a course, moderating discussion forums and holding assessments. Among instructors, there was a sentiment that it would be efficient if we could continue to use the online material that we developed during the pandemic. The advantages of continuing to deliver the lecture content remotely and asynchronously (eg. through lectures videos) include consistent access to lecture content for all students, access to lecture content if a student misses a class, students' ability to watch and rewatch at their own pace. In student surveys at our institutions in 2020 and 2021, students indicated high levels of satisfaction for lectures being delivered via pre-recorded videos.

### ***Enhance In-Person Active Learning and Community Building***

Delivering lecture content online created time and energy to convert the in-person class time to active learning. Active Learning comes in many shapes and sizes. In general, the goal is to engage the students in genuine experiential learning, where they are actively *doing* more than they are passively *listening*. This engagement results in deeper learning for the students (Jazayeri et al. 2020, Cho et al. 2021). The courses were rescheduled from large lecture sections (>200) to ten blocks of 100 students. The course delivery was re-designed with the intention that the same active learning session would be delivered to each of the ten blocks of 100 students. With instructors, graduate teaching assistants and undergraduate learning assistants in the room to support learning, students would work on problems, projects, data analysis, class demos, etc. In the smaller classes, we assigned students to learning communities of 25 to encourage the students to make connections and develop study groups with their peers. Learning Communities have been observed to be a powerful mechanism to help students form bonds, develop a sense of belonging and build strong support networks as well as supporting student mental wellbeing (Ribera et al., 2017; Tinto, 2000; Harms et al. 2001).

### ***Genuine Team Teaching and Teaching Mentorship***

In this model, the teaching team is working more collaboratively to develop and deliver course material. In the conventional delivery of years past, the instructors worked in parallel, each preparing and delivering their own lecture material. In this new model, instructors worked together to develop active learning sessions, and all instructors delivered the same session. This reduces the wasted effort of having several instructors preparing the same material. For each course, we hired a mixture of experienced and inexperienced instructors, to foster an opportunity for teaching mentorship for our less experienced instructors. For example, in one first year course (ENGG 201: Behavior of Gases, Liquids and Solids), the teaching team consisted of experienced and new faculty members, Post-Docs from the department who were new to teaching and one Post-Doc who had no teaching experience. The most experienced faculty member was assigned the Lead Instructor/Course Coordinator role. The remainder of the team was responsible for developing and delivering the Active Learning Sessions, under the supervision and in collaboration with the Lead Instructor.

## **FIRST YEAR BLENDED LEARNING**

In the Fall of 2021, the delivery mode of all 10 courses was updated to a blended delivery mode, with a focus on studio-based in-person experiential learning. First year enrolment is 1000 students, scheduled in 10 blocks of 100 students. The in-person class times are

scheduled in studio-based learning rooms, instead of conventional lecture theatres. In the studio-based learning rooms, students can sit in table of 4 and teaching team can circulate through the room to engage with student teams.

### ***Online Lecture Content***

Each of the 10 technical courses delivers lecture content online through pre-recorded lecture videos, practice problems and short quizzes to test understanding. The online lecture content is available to students through an online learning management system, D2L. Students are expected to engage with 1h – 1.5h of lecture content per week per course. Sample problem solutions videos are posted for students to review. Practice problems are made available. To encourage students to stay current with the weekly lecture material, weekly online lecture quizzes are required to be completed for a small percentage of the course grades. The lecture quizzes tend to be short (one to five true/false or multiple choice questions) designed to test understanding of the lecture material.

### ***In-Person Active Learning***

The in-person content has been redesigned to be team-based experiential learning, including classroom demos, project and problem-based learning, hands-on learning, team-based worksheets, gamified learning and other active learning sessions (CDIO Standard 8).

### ***Seminar Series***

A weekly seminar series was created to support student wellbeing and professional skills topics. Seminars were scheduled for one hour every week and covered various mental wellbeing and learning strategies content. The seminar series is discussed further in the author's companion paper in this same conference series.

### ***Extra Learning Supports***

To support the students in their first year, many out of class supports are available. Learning Assistants are upper year engineering students who are hired and trained through the Engineering Student Centre. The learning assistants are scheduled and available daily to offer one-on-one tutoring for first year students. Upper year students are also hired to run Peer-Assistant Study Sessions to help large groups of students gain extra practice with the course material.

## **THE LEADERSHIP PERSPECTIVE**

The authors of this paper are involved in the leadership team at the faculty. One author is the current Associate Dean, Teaching and Learning. In addition, she has experience teaching one of the first-year courses. The second author has acted in various leadership positions in the school and was brought into the project early on as the "First Year Academic Coordinator". He also has experience teaching one of the first year courses, and was instrumental in the development of the Integrated Learning Stream (Jazayeri et. al. 2020) in the Electrical Engineering program, on which this new first year program was modelled, in part. In the following section, we'll share our perspective of what went on "behind the scenes" to enable this significant change in delivery to successfully happen.

### **Learning Spaces**

The spaces in which active learning are scheduled are important. In order to make this project work, we spent a great deal of time negotiating with The Registrar's Office. We secured 5 spaces for first year delivery. Each room had a capacity of 100 students. The summer was spent renovating the rooms. Instead of conventional lecture halls, the rooms were designed to host 25 tables of 4 students. This allows the students the space to work collaboratively. In the active learning sessions, there are still sections of instructor-led content. The technology in the room is designed to support this. The instructor can teach from a podium, which is fitted with a computer, a document camera, and hookups to connect to other devices (eg. personal lap-tops). From the podium, the instructor can project their work to screens which are set up on multiple walls of the room. This means students can see the screen, regardless of what direction they are facing.

The rooms were booked for the first-year classes all day. Five of the blocks were scheduled in active learning sessions in the morning, and the other five scheduled in the afternoon. The students were given access to the rooms over lunch break and in the evenings, to use as a collaborative workspace.

### **Staffing**

In this academic year, additional funding was provided from the faculty for additional teaching assignments and graduate teaching assistants. For the engineering courses, we implemented a team model. This included one course coordinator and 5 Active Learning Instructors for each of the courses. The course coordinator was responsible for creating the online component of the course, managing communication with the students, coordinating the active learning sessions and setting assessments. The active learning instructors were responsible for designing and running the active learning sessions. In some cases, the active learning instructors were faculty members or experienced instructors. In each course, a few PhD Candidates or Post-Docs were hired as Active Learning Instructors, to support them in their career progression as part of a teaching team.

The faculty appointed a new teaching appointment of "First Year Academic Coordinator". This position was given to an academic staff member with experience in active learning and team teaching. Their role was to coordinate the overall first-year experience. This included communication with students, running collaboration meetings with lead instructors of all first-year courses, and running the first-year seminar series.

In each active learning session, at least 4 teaching team members were assigned to support the students. This was typically the active learning instructor, two graduate teaching assistants and one undergraduate Learning Assistant. At our institution, students of all disciplines take part in an optional 12-16 month work placement in between their third and fourth year. Four full-time student internship positions, "Learning Assistants", were created specifically for this first-year delivery method. The interns are scheduled to be in the active learning session for the engineering courses, to answer questions and give students feedback on their work.

In addition to the teaching team staffing, we assigned support staff to the first-year project. A Teaching and Learning Specialist was involved to help coordinate seminars, manage communication, support instructional team in other ways.

## **Collaboration**

### *Non-Academic*

There are many departments on campus involved with coordination of the first-year program. The planning of this significant change in delivery involved detailed consultation with the Registrar's Office, the Faculty of Science, the Student Advising Office, and student groups. The Registrar's office is responsible for scheduling and space allocation. The scheduling for this new delivery method does not conform to the standard schedule at our institution, so collaborative meetings were required to create a unique schedule for our active learning spaces and for the students. Because the first-year includes five courses taught by the faculty of science, their buy-in was critical to a successful delivery. Our Student Advising Office was a critical partner in this change. They are the first line of communication with incoming first years, and their help with communication and student engagement leading up to September was helpful. And finally, before and during this delivery change, we consulted regularly with our student reps to hear their opinions and ideas.

### *Academic*

Within the ten courses in first year, there has not typically been much communication in the past, despite a widespread acknowledgment by instructors that more coordination would be helpful. We used this change as an opportunity to implement more communication and collaboration between course instructors. The lead instructors of each course met monthly or biweekly from May – April, both when planning courses and while delivering courses. These meetings were chaired by the First Year Academic Coordinator. Throughout these collaborative meetings, instructors were able to coordinate midterms schedules, so students did not have more than two midterms in one week. Instructors made some shared decisions about the overall layout of online course pages, to give students some consistency. When issues arose during the term, these regular meetings gave instructors more ability to create and enforce consistent course policies.

## **LESSONS AND RECOMMENDATIONS**

Overall, our feedback from students and instructors is that the model works well. Students appreciate the active learning sessions, both as opportunities to learn in an engaging way and as a method to connect with their classmates. Instructors and TA's find the active learning sessions a rewarding way to connect with the students and enjoy seeing the "lights go on" when a student suddenly understands a concept. For future iterations, we have some recommendations based on our observations this year:

### **General Learner Orientation**

The transition from high school to university is always a challenge for students, and that is no different in this learning modality. In future iterations of our first-year delivery, we intend to schedule the entire first week of class as a "learner orientation". In this week, we will deliver active learning sessions on topics such as: how to effectively engage with lecture videos, how to learn effectively in a team; how to create a schedule, as well as covering course-specific expectations for the term

### **Active Learning TA/LA Training**

Our Teaching Assistants are a crucial aspect of the success of this program. Having a combination of graduate TA's and undergraduate LA's to support the active learning sessions is a model that works very well. However, for many of our TA's and LA's, the role of supporting active learning is new to them. In future years, we intend to develop a strong active learning training for the TA's and LA's to help them in developing the skills necessary to be effective in active learning spaces.

### **Coordinated Out of Class Supports**

The students appreciate having spaces where they can go to ask their questions out of class, and we have many different programs and opportunities for them to do so (Instructor Office Hours, Learning Assistant tutoring hours, Peer-Assisted Study Sessions, etc). However, since those supports are delivered by different groups of people, their schedules can at times conflict. In future iterations, we intend to coordinate between the out of class supports to minimize time conflicts and increase students' awareness.

### **Seminar Series Engagement**

While students appreciated the general material available to them in the seminar series, attendance and engagement was low. Our delivery method will be updated in future years to encourage engagement.

### **Instructor Face Time**

A challenge with our current instructional model was that students didn't always get a chance to interact face-to-face with the instructor that they saw in the lecture videos. In upcoming years, we will make some changes to the team-teaching model to encourage instructors to have both an online and in-person presence.

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## BIOGRAPHICAL INFORMATION

**Kim Johnston, PhD** is the current Associate Dean, Teaching and Learning & Student Professional Development. Her research focus is in advancing engineering education innovation and supporting student mental wellbeing in the University environment. She has led several significant student-focused initiatives in the school, including implementation of the Engineering Attributes Program and the Blended First-Year Initiative.

**Mike Potter, PhD.** is a Teaching Professor in the Schulich School of Engineering at the University of Calgary. His research in the past has been focused on computational electromagnetics. Currently, he is interested in curriculum and program development, especially integrated learning. He has been involved in several teaching and learning initiatives, including developing the Integrated Learning Stream program in second-year electrical engineering and the Blended First-Year Initiative.

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