Reengineering an engineering course: How flipped classrooms afford transformative teaching, learning, and workplace competency

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Intro / Project description

The researchers collaborated with lecturers teaching a mandatory first-year electronic engineering class to develop a flipped classroom model of teaching and learning and to explore how this approach can enhance student learning of conceptually difficult, threshold concepts and non-technical skills needed for real life work.

What were the aims of the project

The flipped classroom is a student-centered educational approach in which lecturer-student contact time is devoted to student problem-solving and addressing students' misconceptions, thus changing the traditional role of the lecturer and fostering more active student learning. The project aimed to: (1) examine how a flipped classroom model of teaching impacts on lecturers' teaching of threshold concepts, (2) explore the value of the flipped model and its associated strategies for student learning, and (3) examine if and how student learning in a flipped classroom can support the development of workplace competencies.

Why is this research important?

Successful engineering graduates need to have a flexible understanding of engineering principles and practices and to be able to collaborate, communicate well, and work in contexts that can be risky and uncertain. It is crucial that tertiary educators develop curricula that enable students to develop these capacities and enhance student employability to ensure their contribution to New Zealand's economic competitiveness and societal wellbeing. The research expectation was that a TC-based flipped class pedagogical approach would enhance students' learning of TCs and development of non-technical skills necessary for engineering graduates now and in the future.

What we did

Data

We collected data from multiple sources:

- Lecturer and work-placement supervisor interviews
- Student surveys and focus group interviews
- Video analytics on student video viewing behaviors
- Observations, video recordings, and field notes in the flipped classroom
- Student activity in online tutorials
- Student assessment results

Analysis

Data from various sources were analysed separately and together to identify changes in pedagogy and student learning and development. Statistical analyses conducted on the quantitative data identified differences and trends in student achievement and opinions. Qualitative data were analysed using thematic analysis and a collaborative team approach to data analysis was adopted.

Key findings

In our study student learning was supported by lecturers' purpose-made and supplementary online videos, in-class mini-lectures, collaborative problem-solving tasks, online tutorials, continuous assessment, 'drop-in' tutorials, help from the lecturers and course demonstrators during in-class sessions, and the course Moodle forum for question and answer sessions. All of these resources together contributed to students' learning and raised their achievement. Although no direct impact was seen on students' workplace competency development, students saw the value of becoming aware of the value of non-technical skills (e.g., communication and teamwork) in their learning and becoming an engineer.

Implications for practice

Curriculum. To develop good educational materials lecturers need to re-examine the course and select what and how to present when developing materials and pedagogy tailored to their students' needs. Progressive changes are an efficient way to develop the content and the format of the flipped course. Ensuring coherence, and making explicit connections between the course elements are important for student engagement, learning, and satisfaction. Flipped class combined with continuous assessment is an effective model to re-envision teaching and learning at the tertiary level.

Pedagogy. Flipping the class changes lecturers' roles to that of a facilitator of learning. Including a variety of learning supports is essential to meet students' various learning needs. To create short, educationally good quality videos they need to be based on the principles of effective cognitive models of learning and although expensive facilities and equipment are not required time and practice are important.

Student learning. Students' changing role from passive to active learners is essential. For the success of the flipped class, especially for first year students, getting student buy-in, motivating students' timely video watching, and providing additional support for Q&A session is needed.

Institutional support. Institutions need to recognise and support lecturers efforts to develop and enhance their flipped teaching practice.

From left: Elaine Khoo, Jonathan Scott, Mira Peter, Howell Round

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