Paper Title: Student engagement and empowerment in a flipped engineering dynamics classroom

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Submission

The flipped classroom model is increasingly used in tertiary education. Opportunities for active learning, collaboration and interaction with the lecturer are some of the reported benefits associated with the use of flipped approaches. These opportunities improve engagement and empowerment of students.

This paper presents the results of a study on student experiences in a first year engineering dynamics Summer semester course that used a flipped approach. This research used focus group interviews to determine the students' sense of empowerment and engagement in the flipped classroom.

The students' ability to control the pace of their learning and the collaborative nature of in-class active learning led to empowerment and an increase in confidence about their learning. Some students' felt that they lacked sufficient discipline to succeed in self-directed learning. However, reassuring students that their out-of-class learning was beneficial was found to be a potential enabler to their confidence. Student engagement was also positively affected by the ability to control the pace of their learning, their increased flexibility in study timing and location, and active learning during the scheduled classes. Some students noted that their self-directed learning skills combined with workload issues presented unique challenges due to the flipped approach and negatively impacted their engagement.

The paper concludes with recommendations for practice to further facilitate students' sense of empowerment and engagement and may be of particular interest to engineering or other threshold technical subject pedagogy.

Introduction

The purpose of this study was to ascertain first year engineering students' views of the flipped classroom learning experience in a tertiary setting. Flipped teaching and learning is an approach where direct instruction is enabled by digital technologies and experienced individually from each student in their own time, space and pace (Bergman & Sams, 2014). Classrooms are transformed into dynamic and interactive learning environments where discussions are guided toward specific learning outcomes and ensure consistent engagement from the students. In such environments, students are mentored, rather than directly instructed by the teacher.

Increased engagement and motivation, interaction with the teacher, content and other students, and academic achievement have been associated with the use of flipped approaches (Zainuddin & Hajar Halili, 2017). Studies also indicate that students generally prefer the flipped approach to the traditional method of teaching and learning (Wilson, 2013; Jenkins, 2015; Khanova et al., 2015).

McLaughlin et al. (2013) found that student engagement was affected by the flipped classroom format and the increased opportunities for active learning which was achieved via application of knowledge to real-life examples. Similar results were reported by Yelamanthi and Drake (2015) who found that student collaboration on real-life examples positively impacted students' engagement with the course content.

McLaughlin et al. (2013) found that most students were empowered with the use of a flipped approach, as their confidence was boosted in their self directed learning environment and pace. Mason, Schuman and Cook (2013) used assessed quizzes and student comments regarding their knowledge acquisition and found that flipped classroom students were more confident about their learning. Similarly, in Wilson's (2013) study on student performance in a flipped classroom, students commented that they preferred the flipped learning model to the traditional one and felt more confident about passing the course.

The Problem Being Addressed

Recently in tertiary education, there has been an increased interest in alternative teaching methods that make use of educational technologies (Blair et al., 2016). This study was carried out in an effort to assess the effectiveness of a flipped classroom approach in engineering tertiary education. The focus of this paper is on student experiences, particularly in terms of their empowerment and engagement, in a flipped foundational engineering dynamics course. The aim of the study is to assist tertiary education staff who are interested in flipped approaches to identify aspects of the approach that may be empowering and engaging to students, as well as aspects that may inhibit student empowerment and engagement.

Findings of this study may be grounded to the specific context where it took place. Therefore, the context of the study is described in the following paragraph.

The course was offered during the Summer semester (8 weeks) and had two parts, each taught by a different lecturer (Statics and Dynamics). Only the second part (Dynamics) was taught using the flipped approach and was completed in 4 weeks. The flipped approach included pre-class learning using two 30 minute video recorded lectures before each scheduled session and skeleton notes that students could use for note-taking during their independent study. In-class learning included three scheduled sessions per week with questions and answers, example problems, independent and collaborative work between the students. It was the first time for the lecturer applying this approach and most of student participants had not experienced flipped learning prior to this course.

Study Design/Approach

This study used a qualitative research approach to investigate student experiences in the dynamics section of the course. The research was underpinned by the interpretive paradigm. Interpretivist approaches enable researchers to make sense of how individuals construct meanings from their environment (Taylor & Bogdan, 1998).

Semi-structured group interviews were carried out with 18 students in total (9 from the 2014 cohort and 9 from the 2015 cohort). The semi structured interview format enabled the researchers to ask questions about why, what and how participants engaged with the approach (Taylor & Bogdan, 1998). The group format enabled participants to prompt and be prompted by other participants' contributions (Cohen et al., 2001). Due to scheduling constraints two of the participants were interviewed individually.

The interviews were carried out by the first and second author, who were not involved with the instruction of the course. The third author was the lecturer of the course and was ethically constrained from carrying out the interviews. The study was approved by the University of Canterbury Educational Research Human Ethics Committee.

Findings

Student empowerment

Findings of this study illustrate that students felt empowered by the use of the flipped approach and took ownership of their own learning. The use of video to share the lecture content, was a key factor in enabling students to take ownership and gradually build their understanding, since they were able to pause, replay, slow down or speed up the content.

"You don't get as frustrated [...] You listen to it, you stop it, you write down what it was, and then sometimes if you didn't understand it quite, you'd click back and listen to it again". [Student L]

Other students shared that they were able to augment their learning by researching for additional resources, while pausing the content videos.

"I remember one part I just couldn't get it, and it was a relatively big part. I watched this minute-long video, and they just explained it so easily" [Student C]

Students explained that by becoming more confident of their understanding of the course content they were further motivated to attend the scheduled face-to -face sessions.

"I kind of felt prepared and kind of did everything before I went to class, I felt prepared for those tutorials and revisiting in my own time." [Student H]

Students acknowledged that their in-class experience was equally important to independent learning. During their scheduled sessions, they were able to get reassurance, ask questions, collaborate and work on examples in order to further enhance their understanding and apply their newly acquired knowledge.

"That [Questions and answers] was like 10 minutes at the beginning of the class. Now I can go over the problems and do them by myself because I've got those questions, I've got that clarity." [Student I]

Reassurance and feedback was also acquired by the students' peers. Before the scheduled classes, some students chose to work in groups. Within these groups students studied course content together, assisting one another in building understanding and getting more confident. Others received reassurance from their peers during the scheduled classes where they worked together on examples and collaborated on solutions.

"I was [studying] with a very good friend of mine; [...] we'd watch [the videos] together and we'd hit a problem and we'd both sort of work through what the lecturer was trying to get towards, and the next day we'd be very confident in what we'd got and then we'd go and talk to him." [Student D]

Students who were not properly prepared before the scheduled sessions explained that they were not able to maximise their learning and benefit the most from the in-class activities. These students were not always able to follow the discussions and example activities that were taking place in these sessions. Therefore, their lack of preparation was negatively affecting their sense of empowerment.

"There was a couple of times where I went to the tutorials, having only watched one of the lectures, and the felt like I was wasting everyone's time going there." [Student B]

Some students suggested that increased feedback when engaging with the course content independently would further reassure and empower them. For example, not knowing whether they were on the right track during their independent study, combined with a few mistakes that were spotted in the videos sometimes affected student confidence.

"[During my independent study] I wasn't able to ask questions. I'd write it (the question) out on a piece of paper for the next day, but then I'd say, oh I've got this question. Oh, what does that relate to, again? What was my thought pattern at that time?" [Student R]

Overall, many students commented that the combination of pre class independent learning and in class active learning positively impacted on their achievement in this course.

"The flipped learning took a really complex subject, [...] just made it a little bit more learnable - little bit more achievable." [Student P]

Student engagement

In terms of student engagement, the format of the lectures (video format) was a positive factor. This was due to students' ability to control the speed of the video, the reviewability of the lecture and generally the pace of their learning.

"I could pause it, write what I wanted, re-wind it, listen to what that sentence was again, engage what he's actually said, process it, and then move on." [Student D]

Students mentioned that they were engaged with the material due to their ability to watch the lectures anytime from anywhere.

"I prefer doing things on my own time and on my own terms as well. I can pause the lectures and go and eat something, or whatever and then come back and watch it." [Student K]

The scheduled face-to-face sessions also engaged students, who were able to ask questions, receive personalised support from the lecturer, collaborate with one another and work on example problems.

"I would get my answer [in the tutorials] the next day after I saw the videos like really quickly so that was really good." [Student E]

For some, the face-to-face sessions were more engaging than their independent learning time, as they enjoyed the interactions with the lecturer and the active learning that was taking place in their class.

"I got on really well with the lecturer, so coming into the tutorials was actually kind of fun. I'd look forward to winding him up a little bit. So that for me was interesting, whereas sitting in front of a computer screen just sliding the bar back to try and copy out something, was not particularly engaging." [Student R]

Interestingly, the presence of a few mistakes in the content videos further engaged students to participate in the scheduled sessions. Although as mentioned previously the mistakes were negatively affecting student confidence in their learning, students shared that they were further motivated to ask questions during the scheduled classes to clarify the aspects that were confusing.

"That was probably the biggest cause of my annoyance with the course [mistakes in some slides]; if he did that in my class I would have put my hand up [...] I'd ask him the next day in class and he'd be like, oh yeah that was wrong, sorry." [Student D]

For some students, their lack of familiarity with self-paced independent learning combined with the short timeframe that they had to watch the videos had a negative effect on their engagement.

"Then you go the day after into the class and you don't how to tackle the problems because the thing didn't sink yet [...] [During the Summer semester] I was bombarded with new materials everyday like heaps of it, probably my mind couldn't retain it so well" [Student A]

Some suggested that not having other courses to attend during the Summer semester was actually helping them engage with the requirements of this flipped course, regardless of the short timeframe. Students are limited to two courses only during Summer school at the participant university. Others argued that the course over a longer period of time, such as in a non-Summer semester would perhaps assist them in managing their learning, as they would have more time to watch the required content videos and gradually develop their understanding. However the students also predicted that too many simultaneous courses using the flipped approach would be a challenge.

"If I was doing four flipped classrooms at the same time, I think I wouldn't handle that very well." [Student J]

Discussion and Conclusion

This paper discusses empowerment and engagement as perceived by students of a flipped classroom in a first year engineering dynamics course, taught over the Summer semester. Student empowerment was influenced by the medium of delivery that allowed them to control the pace of the lecture and augment their learning with additional resources. Empowerment was also affected by the in-class activities, and by the support students received from their peers before and during the scheduled sessions. Students that were more confident in their understanding during independent study were more likely to engage in the scheduled sessions. Further reassurance during students' independent study was noted as a potential way to increase their sense of empowerment.

Student engagement was affected by the medium of delivery that enabled them to control the pace of the lecture during their out-of-class learning. The flexibility to learn anytime from anywhere was perceived as an engaging factor, as well as the active learning during the scheduled sessions. Factors that negatively affected student engagement included students' level of self-management skills combined with workload issues and short time frame during the Summer semester.

During their self-paced learning, the medium of delivery enabled students to pause, replay, speed up, or slow down the video and find additional resources to augment their learning. This increased both their sense of empowerment, but for some, it also enhanced their engagement with the course. Mason et al. (2013) found that the ability to control the pacing of the lectures and their reviewability was identified by students as fundamental to their learn-

ing. Delivery of content in a way that allows students to govern their own pace of learning may further facilitate students' experience and therefore may be considered during the tool selection process from teaching staff.

The flexibility to access and learn the course content anytime from anywhere was perceived as a engaging factor from the students, which agrees with findings from other studies (Kerr, 2015; O'Flaherty & Phillips, 2015). Some students mentioned that this flexibility may be challenged when students have a shorter timeframe to complete their independent learning tasks, as well as their ability to manage their learning. Such challenges encountered by students, including those that are workload related, concur with the findings of Green and Schlairet (2017) and Khanova et al. (2015). These findings also highlight the need to provide students with a combination of clear expectations of time commitment and suggested strategies to assist with self-management.

Regarding the scheduled sessions, students almost unanimously agreed that the face-to-face sessions were not only interesting and engaging, but also were enabling them to deepen their understanding. This was due to a combination of increased time to ask questions, work on example problems and clarify concepts that required further explanation. Mason et al.,(2013) and Yelamanthi and Drake, (2015) identify one of the main benefits of the flipped approach is that it frees up more time for active learning. Students who were not adequately prepared before scheduled classes found that they were not able to fully benefit from them. Therefore, in addition to clear expectations communicated to the students, careful design of in-class activities should include opportunities to gauge student understanding of core concepts, in order to direct the session according to student needs.

Students also mentioned the value of peer support during their independent learning and scheduled classes. Although collaboration was not compulsory in this course, students were strongly encouraged to form study groups and learn from one another throughout both stages of the flipped classroom. Flipped approaches can provide increased opportunities for student collaboration (Lavelle et al., 2013), but the use of a flipped approach is not enough to guarantee collaboration. The teacher's approach in fostering a collaborative culture is very important and therefore such opportunities need to be purposefully designed (Foldnes, 2016).

In conclusion, the flipped classroom approach was well received by the students of the first year dynamics class. Students who were disciplined and were able to self-manage appreciated the class the most. However, there were some key findings in the research that must be considered when a flipped classroom is to be used in similar threshold subjects at a university level. In particular, students must be warned that their success will be linked to their discipline in engaging with the course material. Furthermore, the video format and focus on collaborative learning were generally well received across the cohort.

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