Flipping your classroom
without flipping out

K. Willey
Senior Lecturer
The University of Technology, Sydney
Sydney, Australia
E-mail: keith.willey@uts.edu.au

A. Gardner
Senior Lecturer
The University of Technology, Sydney
Sydney, Australia
E-mail: anne.gardner@uts.edu.au

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INTRODUCTION

There is some contention as to who are considered to be the pioneers of flipped learning. Within the secondary school system Bergman and Sams, who used live video recordings and screencast software in 2007, are frequently mentioned [1- 3]; while within the tertiary sector, Mazur's work on peer instruction is often highlighted [4, 5]. While the phrase 'flipped learning' may be relatively new it has been practised by numerous academics and teachers for decades, and is the disciplinary norm in some contexts, for example, it is extensively used in social science classes.

To find a popular accepted definition of flipped learning we consulted Wikipedia, which describes it as "...*a form of blended learning that encompasses any use of technology to leverage the learning in a classroom, so a teacher can spend more time interacting with students instead of lecturing*" [6]. We would modify this definition to omit the need for the use of technology, while it is common practice to replace in-class lectures with online video or audio files, out of class readings from text, notes or inquiry-based activities using non-online resources may also be used. Hence the requirement for flipped learning is that didactic transmission-based lectures are at least in part replaced with out of class tasks allowing class time for participative learning activities. Additionally, we would suggest that it should be referred to as flipped instruction as the learning should occur at all stages of the process. Flipped activities should preferably require students to engage in dialogue and include assessment (typically formative) to allow students to evaluate their understanding or progress. Furthermore, flipped instruction should not merely create

an opportunity for academics to provide more personal feedback and assistance ***to*** students, but also to receive feedback ***from*** their students about the activities that they are undertaking and what they don't yet understand. In this way the learning environment is socially constructed as the academic responds to the learning needs of students and hence together they combine to influence the nature, focus, complexity and timing of activities undertaken.

This paper reports a pilot study investigating flipped instruction. This study enabled us to explore some of the misconceptions associated with flipping, and provide insights and recommendations to assist instructors to successfully flip their classrooms without flipping out.

1 BACKGROUND

There are many misconceptions associated with flipped instruction [7, 8]. These misconceptions can in part be attributed to a narrow understanding of what is meant by flipping and a lack of awareness of components that should be considered in designing flipped activities.

Firstly, flipped instruction often requires more effort from both students and instructors. In the transmission lecture mode most students don't attempt to pre-learn a topic prior to in-class instruction after which they typically undertake self-organised study combined or interleaved with scheduled tutorials to learn the required material. In flipped design, it's not a matter of simply moving lecture content out of class and moving previous out of class activities, such as study, into class. The idea behind flipped instruction is to fill the released class time with additional interactive and collaborative learning opportunities. This requires both instructors to prepare more material and students to undertake more activities (*Fig. 1*). While the potential benefits make the additional effort worthwhile, it is common for both students and instructors to underestimate the additional time demands and skills required in flipped instruction.

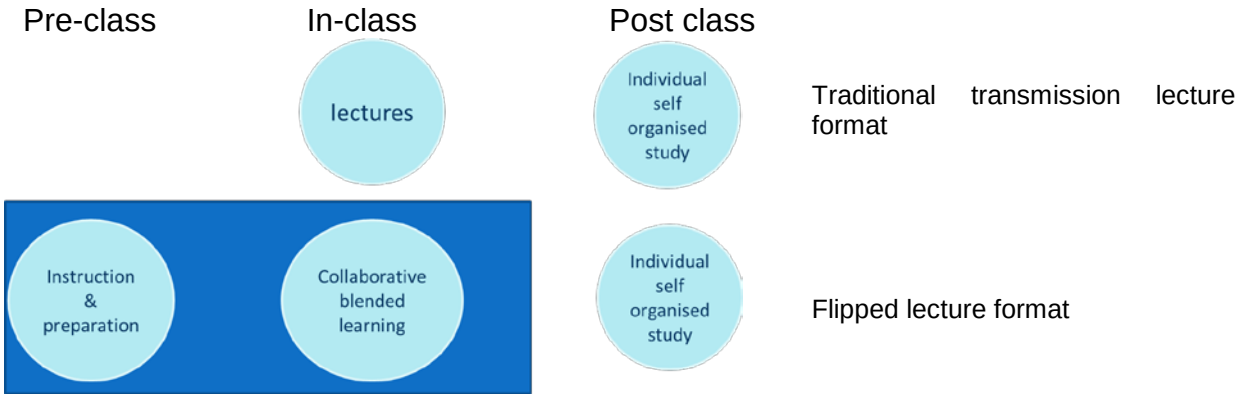

Fig. 1. Flipped instruction introduces additional learning opportunities/activities compared to the traditional transmission lecture mode.

Secondly, not all students will embrace or necessarily like flipped instruction. The increased work expectations associated with flipped instruction is one reason while other common student complaints are:

- they 'paid' to be taught by an expert not other students,
- that they don't have the judgement or expertise to learn from each other, and
- that flipped activities are often formative and hence they do more work but it does not directly contribute to their final grade.

Students' participation in flipped instruction is dependent on a number of factors including disciplinary norms of learning and assessment methods. We have observed that within the social sciences for example, there is a culture of students expecting to undertake out of class activities to enable in-class debate, discussions and deep exploration of the outcome to be learnt. For example, in literature classes it is expected that students will read novels outside of class, allowing class time to be spent discussing aspects of the work. Conversely, in engineering, students often expect to receive didactic instruction, an expectation reinforced by the standard lecture delivery and examination assessment format regularly used to accommodate large class sizes. In addition, in engineering, material is often seen as being deterministic, learnt sequentially, to be used to solve a problem and arrive at a single correct answer. Furthermore, assessments that allow students to follow procedures instead of demonstrating analysis, evaluation or creativity, often encourage repetitive rote, 'recipe' or roadmap approaches to learning. Even laboratories are frequently designed such that students simply report rather than interpret what they found. While we acknowledge that approaches such as inquiry, problem and project-based learning have the capacity to address the above issues, this depends on how well these activities are designed, how frequently students encounter these opportunities within their degree programme and whether the associated assessment requires students to demonstrate these skills. We would suggest that too many students pass their engineering assessments without developing the skills required for independent inquiry-based learning. This problem is reinforced by a culture of students following an expert, rather than finding their own way, leaving many without the confidence to exercise their own judgement.

Some students report being unenthusiastic about undertaking out of class preparatory and in class collaborative formative activities as they often don't contribute directly to their final grade. The culture that effort should be rewarded with marks is reinforced by invalid assessment. Sadler [9, 10] discusses the concept of assessment fidelity, defining this as "...*the extent to which elements that contribute to a course grade are correctly identified as academic achievement*" [10, p.728]. Sadler [10] also challenges us on the practice of progressive accumulation of marks from tasks set at a lower level than the threshold level for the subject (eg simple quizzes). Students start with different prior knowledge and learn at different rates and hence take different paths to reach the same level of achievement. Thus if marks are awarded for cumulative assessments *"in which early understandings are assessed, recorded and counted"* this *" misrepresents the level of achievement reached at the end of the course "* [10, p.735].

This culture of learning and assessment is a created system. Social-cognitive theory argues that people don't operate in isolation, but rather in response to social systems within which they exercise various agencies. Agency is the "*capacity to exercise control over the nature and quality of one's life*" [11]. Self-efficacy, the belief in one's capacity to organise and carry out the actions required to achieve one's objectives [12], is important in developing individual and collective agency: "*Unless people believe they can produce desired results and forestall detrimental ones by their actions, they have little incentive to act or to persevere in the face of difficulties*" [11, p. 11]. This has implications for participation and perseverance in learning activities and retention in engineering programs overall.

The motivation for this research is to investigate these issues of learning and assessment design by analysing the learning experience of students undertaking flipped instruction in a senior level Telecommunications subject at the University of Technology, Sydney (UTS) in the Autumn semester of 2013.

2 METHOD

Continuous Communications is a stage 6 (of 8) Telecommunications subject within the Information and Communication Technologies (ICT) Engineering degree at UTS. In Autumn semester 2013 the first author taught this subject for the first time. Since the content was to be changed from previous semesters, there was little prior material available to use. At the University's request given our previous experience with flipped instruction, it was decided to flip the subject to illustrate the use of innovative teaching methods and spaces promoted through the university's Learning2014 initiative [13]. Given the short preparation time, the first and second halves of the subject were delivered differently. While the whole subject involved flipped activities, ie. out of class preparation for in-class collaborative activities, in the first half of the subject some material was still delivered in traditional lecture format. In the second half of the subject these short lectures were replaced by a series of online video presentations (maximum five minutes in length) that were aimed at helping students to understand difficult and/or threshold concepts.

The subject combined out of class readings, formative assessments, inquiry-based learning activities and online video presentations, with in-class formative collaborative activities and summative assessment. The in-class activities were specifically aimed to improve students' learning experience and designed as an opportunity to engage with the subject material at a higher level as opposed to introducing additional content or an opportunity to do tutorial work. That is, the activities were designed to engage students at the higher levels of Bloom's taxonomy, to analyse, evaluate and create, rather than to simply understand or remember. These activities also incorporated the features of variation and confirmation as outlined by Willey and Gardner in their collaborative learning framework [14] as shown in *Fig. 2*:

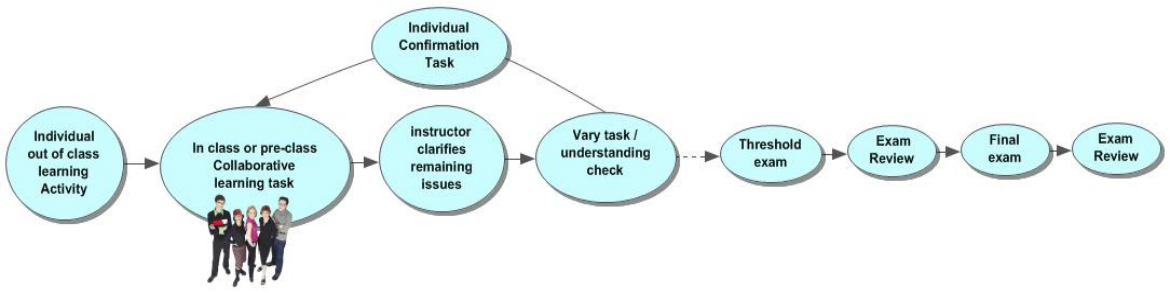

Fig. 2: Collaborative Learning Framework as implemented in Continuous Communications in Autumn 2013.

A common mistake for instructors new to flipped instruction is to spend too much time producing high quality out of class video presentations or lectures and insufficient time preparing activities for the freed up in-class time. Keeping this in mind we deliberately aimed for the online resources to be low in cost in regard to both the time and effort required to produce them. For example given the short preparation time the majority of the online notes were handwritten and diagrams hand drawn, the video presentations were made in one long take, edited to remove errors that were corrected on-the-fly (nine, five minute presentations were produced from beginning to end in a few days). In addition, third-party resources for example Tutor Tims (http://www.qpsk.com) or freely available web resources and applets were used as tools in the inquiry-based learning activities.

The class was small, having only 24 students, although senior students, all were undertaking their first flipped instruction subject. Their perceptions of flipped

instruction were investigated through observation and informal discussion, and nine students agreed to participate more formally including completing a survey containing both multiple-choice and free response questions. The focus of the discussions and the survey questions was on understanding the impact of the flipped activities on students' learning experience including any changes in how they approached their studies or managed their time.

3 RESULTS AND DISCUSSION

Student responses to four of the survey questions are shown in *Table 1*. The frequency rather than the cohort percentage of the chosen response has been shown as with small numbers percentages can often suggest an increased significance.

Table 1. Student responses to survey questions

Question	Frequency of Answer			
	Often	Rarely	Once	Never
I used the online learning resources (online videos, pre class problems and tut problems etc)	5	3	1	0
	Disagree	Agree		
The fact that the collaborative learning activities (in-class quizzes, pre class problems) were formative (not worth marks) meant I didnt see them as valuable.	6	3		
	Disagree	Agree		
The fact that the collaborative learning activities (in-class quizzes, pre class problems) were formative (not worth marks) meant that I often did not complete them before class but instead used my time to complete summative (worth marks) activities in other subjects	5	3		
	To prepare for the collaborative in class activities	After the in class activities to check my understanding of what we did	To revise for the exam / exams	I did not use the online mini lectures
I mostly used the flipped videos (mini lectures) posted on Blackboard:	1	4	4	0
	They allowed me to work on a problem and check my understanding	I didnt like them as it was up to me to check my own answers.	I didnt check the answers with the Tutor Tims so I was not confident my answers were correct	I did not use these resources
In regard to the Self-directed inquiry-based learning opportunities posted on Blackboard:	3	1	2	2

The students who reported using the online resources *'often'* were from a wide range of final exam grades being those that failed (< 50%) (1), received between 50% and 60% (1), 60% and 70% (1) and 70% and 80% (2). Their explanations of how they use the resources included *(Note: in the comments below the student's examination grade range is shown in brackets. While we acknowledge a student's grade range is an indication of their demonstrated achievement against the subject learning outcomes, it may not necessary be an indication of their capacity to meet these outcomes. The grade ranges have only been shown to reflect that there no significant relationship between a particular student view and their subject grade):*

"because we can actually go through the online video before we can go to lecture it will b easier to understand and we can ask more questions in the class then understanding materials during the lecture"[sic] (70% and 80%).

"the online videos were extremely helpful. I was able to pause and repeat some parts … where I lacked understanding and comprehend it better, especially during exam period" (60% and 70%).

The students who chose to use the online resources rarely or only once were also from a wide range of final exam grades being those that failed (< 50%) (2), received between 50% and 60% (1) and 70% and 80% (1). Their explanations for not regularly using the resources all referred to their low quality: they were *"not really nicely displayed*" *(70% and 80%)* and they were "*not clear and not good enough at all" (< 50%)*. While low self-efficacy may be a factor in these students not persevering with these activities, each reported being put off by the low production quality of the video resources.

Five students reported they perceived the flipped activities to be valuable even though they were formative rather than summative in nature. For these students the fact that they were formative was not an impediment to either completing the activities before class or preferencing summative activities in other subjects:

"As the lecturer kept mentioning, these activities were there to point out to us directly what we did or more importantly, didn't understand. I found these activities a great way to test my understanding without losing marks" (70% to 80%)."

This comment illustrates some of the scaffolding used by the instructor to create a learning-focussed environment within the subject to motivate students to undertake the formative pre-class activities with a focus on learning. Our preliminary investigation suggests we cannot assume that all students will have the self-efficacy to undertake/engage with the out of class preparatory component of flipped activities. Hence if we want students to participate in flipped classrooms we need to provide scaffolding and support to help them develop and/or strengthen the required skills. In developing scaffolding we recommend that a good place to start is for instructors to explain to students [14]:

- why they designed the activity the way they did.
- what learning opportunities the activity provides the students
- how students can evaluate their learning from the activity
- how the activity is going to impact on their reality (enable them to see the world differently)

Students that would have preferred the activities to be summative were mainly concerned with either providing motivation for themselves or their peers to be better prepared and hence more engaged with the activities:

"If I had spent more time on the formative activities, I wouldn't have struggled before the threshold exam to "catch up" on the missed concepts." (60% to 70%)

"it would be even better if in class activities carries at least 10 percent of the finals so at least some student will pay more attention on going through online material before the lecture." (70% to 80%)

Eight of the nine students reported using the flipped videos (mini lectures) mostly for revision purposes which supports our intention of focussing the short videos on threshold or hard to understand topics. Students described using these videos to not only prepare for the in-class activities but also as a form of self-assessment that enabled them to check their understanding, identify misconceptions and subsequently have them addressed through their own revision, discussions with their peers, or consultation with the instructor. One student explained that they used the online resources to catch up on missed lectures during busy academic weeks:

"some of the lectures were during peak time for university assignment submissions in other subjects, I skipped the lectures of continuous communications which were online, so I just studied from online during the same week as the lecture… so that can follow up in the next class" [sic] *(70% to 80%).* Students most commonly reported the best things about the flipped learning approach to be: it assisted them to *"study anytime, staying at home"* or at a *"time whenever best suits me" (70% to 80%);* that it made it *"easier to understand … during the lecture time" (70% to 80%)* and that it allowed class time to be used for collaborative activities. Conversely, students found the worse things about the flipped learning approach were that it was "*rather confusing to start with" (<50%)*, that there was a temptation knowing the material was available online to postpone study to later in the semester and that this required them to exercise more discipline. Finally, a few students reported that while they liked the flipped learning activities they would have preferred that they also received traditional type lectures and that they wanted more questions with worked solutions and answers explained in class, as they lacked the confidence and judgement to check their own understanding. These comments illustrate how student agency and self-efficacy, or lack of it, can impact on their engagement with learning activities. While scaffolding helped students with these issues we suggest that regular exposure to flipped activities in other subjects would help students learn how to use this type of instruction to their advantage.

Our observations of in-class activities centred on students' engagement which was initially below our expectations. The instructor tried a number of ways to increase engagement but observed the best result after demonstrating to the students how he walked around the classroom and through listening to their dialogue as they collaboratively solved a problem identified their misconceptions, addressed them and subsequently deepened their understanding through exploring variations of the problem. Through this exercise students realised that if they didn't prepare and participate the instructor did not know what their particular misconceptions were and hence would not be able to address them. As well as demonstrating the process involved, this also highlighted to students their collective agency with regard to the learning opportunities provided by the instructor, ie how they could drive the learning in the subject. Participation in both out of class and in-class activities increased as a result.

4 RECOMMENDATIONS

We recommend that instructors start small, flipping an initial topic that students find difficult and use a combination of both observations and student feedback to improve subsequent designs. Another reason to start small is that it takes more time to flip a topic/module than most people expect. To help with this issue we suggest using as many existing resources as possible, eg youtube, applets, Merlot, World Lecture Hall

During collaborative learning activities take the opportunity to listen to your students' dialogue with each other, this is valuable feedback on their common misconceptions and how to tailor further activities to their needs. Resist the temptation to provide premature closure ie don't give them the answer too quickly. We have found that once some students have an instructor provided answer they accept it without question, discontinuing discussion and hence don't use or test their own judgement in learning the concepts, inhibiting their capacity to use them in different contexts.

We also recommend that pre-class activities are formative. Formative activities free students from the burden of strategically collecting marks and encourage a focus on learning. They provide opportunities for students to practise and get it 'wrong'

helping them to identify their learning gaps and have them addressed before demonstrating their learning in summative activities. However, we acknowledge well designed scaffolding is required to promote participation of some students.

5 CONCLUSIONS

Although flipped instruction activities have the potential to improve learning outcomes, this does not occur without the commitment of additional time and resources on the part of academics and their universities, and a change in learning culture amongst students. In this study students reported issues in regard to time management, study planning and a lack of confidence in their approach to self-directed learning. We recommend that academics interested in trying flipped instruction start with one topic, evaluate how their students respond and receive feedback from them to drive improvements for the next implementation. Supporting scaffolding is required to assist students with this approach and help them develop the skills required to make the most of flipped instruction opportunities.

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