

The Rise of the Flip: Successfully engaging students in pre-class activities through the use of technology and a flipped classroom design template.

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Educational literature has acknowledged that teaching students who are prepared for class encourages student engagement and active learning. This is a core reason why the flipped classroom has risen to the forefront of effective learning strategies. However, key to the success of this strategy lies in the ability to motivate students to complete the necessary pre-class activities, posing a real issue in higher education settings. Teachers still ask *'How can I be sure if my students have completed their pre-class activities? How do I motivate students to want to engage in pre-class preparation?'* This paper will demonstrate how mindfully designed pre-class learning approaches can successfully motivate students to complete pre-class activities that prepare them for active in-class learning. A pilot design template created by a community of colleagues, highlights how the use of simple technologies aligned to sound pedagogies, effectively engage students through accountability across a range of undergraduate courses.

Keywords: Design template, flipped classroom, pre-class activities, learning technologies

Introduction

Flipped Learning is a term that is associated with a contemporary learning and teaching strategy and often defined as a reversal of lecture and homework elements enabling class time to become more interactive. The popularity of the flipped classroom is reflected through the rise in educational commentary through the literature and various online collaborative sites such as Jon Bergmann's (2016) *Flipped Learning Network*. Early versions of flipped learning can be traced back in the literature as early as 1990's when Mazur (1997) changed the face of physics education with Peer Instruction and Novak et al. (1999) brought Just in Time Teaching to the forefront of learning. Flipped learning is not a new phenomenon in education but what is new about this approach is the way in which educators can use simple technologies and instructional design frameworks to successfully flip their classes.

The translation of the flipped learning concept into effective classroom practice still presents students and educators with innate challenges. Academics across 26 Australian and North American universities where the University of Adelaide's Office of Learning and Teaching (OLT) Flipped Classroom Project Team have conducted a range of capacity building workshops, identified the issue of student acceptance of active learning as one of the challenges of the flipped classroom. Effective flipping relies on students being prepared to assume a much more active role in the group based classroom activities. For this to work effectively, students need to enter the classroom with the same level of understanding of the topic's foundational concepts (McCormack, 2001). Pre-class learning can help to address this, but engaging all students in pre-class learning is still at the forefront of teachers' concerns. Simply pre-recording lectures and placing them online, asking students to watch videos or read chapters of text, does not guarantee student pre-class engagement. The success of flipped learning is dependent on students completing the pre-class activities which are strategically linked to all phases of learning. In this model the educator becomes the 'coach on the side' in-class and the students become the drivers of their learning (Gilboy et al., 2015) whilst they engage with higher order learning activities under the guide of their teachers.

The need for an underpinning instructional design framework is crucial to successful flipped classrooms, along with an understanding of how to use technologies effectively to support the achievement of learning outcomes to close the learning cycles in a flipped classroom (Porcaro et al., 2016). Professional educators who are reflective and engage in scholarly networks are essential to effective flipped learning (Hamden et al., 2013). The collaborative and collegial development of flipped learning resources provides educators with the opportunity to share ideas, success and challenges, and consequently create quality assured learning resources for effective flipped classroom outcomes. Furthermore, discipline experts may not have the necessary skills of knowing how to embed active learning segments that are aligned with authentic assessment practices. This calls for discipline experts to be willing to work in collegial teams, such as an interdisciplinary community of practice (Wenger-Trayner, 2015) to provide them with the support and critical feedback necessary to design flipped classes. This concise paper will discuss the use of a collegially developed flipped classroom design template created by an interdisciplinary community of practice with a special focus on pre-class student engagement. Examples of well-designed pre-class activities from three different undergraduate contexts along with student engagement rates will form the basis of this paper and demonstrate the principles of the design template. It will also demonstrate how these teachers use simple technologies to motivate and engage students in their flipped learning approaches.

Developing the flipped classroom design template.

A design template (Table 1) was developed by colleagues belonging to a cross-disciplinary community of practice that consisted of academics and educational designers with varied experiences in flipping learning design and implementation. The majority of colleagues also belong to the University of Adelaide's OLT Flipped Classroom Project. Outcomes of these collegial discussions informed the design of a user-friendly template to encourage best practices in flipped classroom learning design. Using Bloom's Modified Taxonomy (Anderson & Krathwohl, 2001) as the underlying instructional design framework, the pre-class learning activities introduce foundational key concepts of a specific topic. Through embedded interactivity, students engage with learning activities to help them to remember and understand the pre-class content prior to attending the linked in-class session. Central to the success of pre-class learning activities is the focus on foundational or threshold concepts (Meyer & Land, 2003). These are concepts of a topic that a student must demonstrate understanding of in order to be able to move to the more complex aspects of the topic in subsequent classes. Foundational concepts should form the basis of the pre-class activities and need to be presented in an engaging and interactive manner. A workload shift is central to the success of pre-class engagement to ensure that pre-class learning is not adding to students' workload, but rather shifts a portion of the content from in-class to pre-class.

A set of principles were developed through collegial review of current flipped classroom practices. These principles form the basis of the flipped classroom design template and are accompanied with examples in each phase of flipped learning. Student accountability to complete the pre-assigned learning activities is captured through either the submission of responses to pre-class online 'checkpoints' or through the expectation that students will bring their completed tasks to the linked face-to-face class to form the basis of further learning. Teachers must also demonstrate accountability through the review of pre-class student responses, providing feedback to those responses and finally clarifying any misunderstandings that resulted from the pre-class tasks in the linked in-class session/s. In this design template there are clear linkages between pre-class, in-class and post class, which underpin the need for both teacher accountability to respond to student learning issues and student accountability to complete the learning tasks throughout each cycle.

Flipping across diverse undergraduate courses

When classes consist of students with diverse levels of understanding, the teacher is faced with the challenge of supporting the students who are learning a subject for the first time whilst at the same time challenging those students who are at a more advanced level of understanding of the same subject. As there are no existing pre-requisites for students entering specialised programmes such as oral health, some first year students undertaking human biology are challenged with complex terminology and abstract concepts. On the other hand, other students with a more advanced understanding of biology need to be extended and further challenged.

As early as 2010, the human biology teaching team in the oral health program introduced flipped classrooms to address these diverse levels of student understanding by enabling students to actively engage in class activities to develop a common understanding of the foundational concepts. Similarly, general sciences courses are also faced with the challenge of diverse student cohorts as they enrol students from a variety of degree programs. These students are not only studying for different vocations but may also vary in age, work and life experiences and English language proficiency. To appeal to such a diverse range of students and reinforce the relevance of the content, a flipped classroom approach was adopted in 2013 in the Animal and Veterinary Sciences, Agricultural, Viticulture and Oneology course. The aim of this flip was to introduce the topic of genetics in a real life context so that students develop the same foundational understanding of the key concepts before they engage in real life scenarios and case studies specific to each degree programme in follow up classes. As in the oral health example, it was important to ensure that all students had the required foundational knowledge to enable an interactive and

engaging face-to-face in-class experience.

As well as the challenge of having diverse student cohorts, class sizes in many science disciplines have increased significantly over the past 3-4 years. This is particularly so at first year level, due to the removal of the enrolment caps and the increasing global nature of higher education. This increase in enrolments has not been matched by increasing numbers of academic staff (Brown et al., 2010). The resulting decline in staff to student ratios has led to a reduction in the types of assessment. For example, first year students are no longer required to write scientific/lab reports as the time required to mark these more lengthy reports is too high. Consequently, second year students are expected to write comprehensive laboratory reports but have not yet developed the skills to do this. This problem prompted the development of a flipped tutorial in a second year Animal and Plant Biochemistry course to introduce students to the foundational scientific writing skills required to produce a laboratory report.

The large second year cohorts of Animal and Veterinary Sciences students also posed issues of student engagement and understanding of content heavy topics such as the structure and function of haemoglobin. Student attendance to class and engagement was traditionally low and summative exam questions on based on core concepts for this topic were generally poorly answered. To overcome this issue, the topic was flipped to engage students prior to attending the linked classes using the principles of Team-Based Learning (TBL) (Sibley & Ostafichuk, 2014). The aim of this approach was to allow students to learn the structure of haemoglobin individually as a pre-class activity and then to apply their understanding to real world applications in an in-class group work activity, helping them to make sense of their learning, and thus increasing student engagement.

Design of the pre-class activity across contexts to promote student and teacher accountability

In our flipped classroom template, the aim of the pre-class activities is to introduce students to the expected learning outcomes for the subject and provide them with the opportunity to develop an understanding of the foundational concepts. Pre-class activities need to be short, interactive and focused on these key concepts. Here is where technology aligns with flipped learning pedagogy to support and enhance the implementation of effective flipped classes. The technologies that teachers use to flip with need to be user friendly for both the teacher and the student, and not require large amounts of time to be spent on resource development at the expense of the pedagogical integrity of the flipped class. Once the pre-class activities are completed, students move to higher order thinking levels during in-class and post-class learning and assessment activities. (Refer to Table 1 for examples of in-class and post-class learning approaches.)

Pre-class activity in Health Sciences

Understanding the histological appearance of oral tissues was one of the most important outcomes for oral health students studying Human Biology I OH. Students need to achieve this outcome in order to apply this knowledge to clinical practice. Applying this knowledge to oral health practice required a sound understanding of general cell biology. A 20-minute interactive and narrated PowerPoint was produced on general cell structure. This online module contained embedded checkpoint questions every 5 minutes to flip this introductory topic. Checkpoints consisted of 4-5 simple recall Multiple Choice Questions (MCQs) that were powered by Survey Monkey and linked to the Learning Management System (LMS). Three relevant 1-2 minute YouTube videos on cell structure were also embedded in the pre-class learning module.

Students were allocated a week to complete this pre-class module and the time saved from having to cover this foundational knowledge in class was then dedicated to more applied cellular physiology questions in the linked classroom time. The due date of completion was 24 hours before the scheduled in-class session and the pre-class responses were collated and analysed by the teachers to clarify any salient points in class, prior to moving on to more complex and collaborative learning activities.

The design of the module allowed students learning this material for the first time to undertake the pre-class activities as often as needed, and those who had mastered the content previously could use the checkpoints as a revision tool. As such, all students were prepared for the face to face session. The in-class activities required students to collaboratively identify cells from a series of histological slides. In post class sessions students needed to identify how cells of the oral tissues specialised to perform their particular function. Embedding this form of interactivity in the pre-class activities with clear post class linkage resulted in a consistent completion rate of an average of 95% despite the fact that completing these learning activities did not contribute to the assessment marks for this course. Initial data emerging from student focus groups indicate that providing them with a due date to complete the pre-class activities, coupled with the regular interactive checkpoints motivated students to complete the assigned tasks.

Pre-class activity in General Sciences

In the general sciences program, the aim of introducing a flipped class to second year genetics students was to show how scientists use biotechnology in their field of study and assist students to understand the complicated terminology of molecular biology. For this purpose, controversial topics such as genetically modified organisms were presented to all students regardless of their chosen vocation.

One week prior to the face-to-face session, students were required to complete an interactive online exercise via the course LMS. The exercise was developed using the Articulate Storyline software and included information, voice-overs, videos and MCQ checkpoints for students to test their knowledge. The main focus for this pre-class activity was for students to gain an understanding of how genetically modified golden rice was developed, the techniques used to create a genetically modified line, such as golden rice, and the corresponding societal benefits. The aim was to help students form their own opinion about genetically modified organisms by reviewing opinions for and against modified foods. The completion of the pre-class exercise was monitored in the LMS Grade Centre. Even though no marks were associated to the pre-class activity, approximately 80% of students viewed and attempted the pre-class activity consistently over 3 years. The linked in-class activities required students to work in groups and refer back to their pre-class responses, making them accountable not only to themselves but to their group members to enable effective and equitable contribution to the in-class group tasks.

Pre-class activity in Animal and Plant Sciences

In Animal and Plant Biochemistry, a second-year laboratory report writing exercise was flipped early in the semester to introduce and familiarise students to the core foundational aspects of this scientific exercise. Students were provided with a fictional electronic example of a laboratory report containing many commonly made student errors. Students were also provided with examples of well-written reports and graphs via their LMS. A simple online rubric, based on the one used to assess laboratory reports Animal and Plant Biochemistry was linked to the example report. Students were required to mark the fictional laboratory report against the rubric before coming to tutorial where they would share their pre-class marking experiences. Students were expected to spend 30 minutes completing this pre-class exercise and were accountable for coming to class with the completed marked report.

When the students arrived for the in-class session, they were provided with a mini-lecture on report writing and were asked to review the pre-class laboratory report again in pairs. Using a much more detailed rubric student pairs had to mark the report again and provide comments to justify their marking. The pre-tutorial activity contributed to the overall tutorial marks for this subject, creating a layer of accountability that supported the completion of the pre-tutorial activity. Over 90% of the class completed the online pre-class activity and submitted the annotated hard copy after the in-class session over the last 2 years. The conceptual link of the pre- and in-class activities to the post-class activity was clear: during the following practical classes students undertook experiments, collected data and were required to write their own laboratory report.

Pre-class activity in Animal and Veterinary Sciences

The Articulate Storyline software suite was once again used to create an interactive pre-reading package covering the basics of haemoglobin structure and oxygen transport for first year Animal and Veterinary Science students as preparatory work for the in-class TBL session. The haemoglobin eLearning package included a narrated presentation of basic facts, figures and definitions as well as a relevant YouTube videos. This package was then uploaded onto the LMS as a SCORM package.

The number of students that completed the eLearning package was tracked through the LMS Gradebook centre. Around 90% of the students engaged with the pre-class learning module. The students were held accountable by using the GRAT (Group Readiness Assurance Test) in TBL, meaning that if they came to class unprepared they would have let their team members down. The analytics available in the LMS provided teachers with the opportunity to track how long each student had the SCORM package opened and how many times they viewed it. In class the students role played haemoglobin loading and unloading, followed by a physical activity that involved them exercising on stationary bicycles and then discussing and diagramming how exercise shifts the haemoglobin saturation curve. To align learning with assessment, one of the application exercises formed the basis of a long answer question in the written summative exam. The combination of the pre-class preparation, the in-class accountability resulting from the team based test, the physical nature of the in-class application exercises and the post-class assessment in the exam resulted in a learning experience that catered to a diverse range of learning styles as was evidenced in student feedback from formal course evaluation surveys and through informal discussions with students.

Discussion and Concluding Comments

In each of the cross-disciplinary examples described in this paper, the flipped classroom approaches were carefully aligned to the design template presented in this paper. The collegially developed flipped classroom template demonstrates how effective flipped classes can be designed with careful planning that considers alignment to learning outcomes and assessment. The use of familiar and simple technologies supported the pedagogical integrity of the flipped classes described and did not drive the learning process. Effective flipped classrooms require careful consideration of the underlying pedagogical framework/s and begin with well-structured and engaging pre-class activities. Based on the experiences of interdisciplinary colleagues from the University of Adelaide's Flipped Classroom Community of Practice, mechanisms such as tracking student completion of pre-class activities and responding to the students' submitted answers embeds both student and teacher accountability which seems to motivate students to complete pre-class activities. The examples covered in this paper, demonstrate how succinct pre-class activities which are mindful of student workload and cover foundational concepts in a self-paced manner lead to successful pre-class engagement. The challenges of flipped classrooms still remain for both students and teachers however strategies that may address some of these challenges can be adopted through the use of a design framework and simple technologies that serve to motivate students and increase student engagement in all phases of learning.

Table 1: A Community of Practice Flipped Classroom Design Template.

All learning segments aligned to clear learning outcomes and assessment				
	Pre-class <i>Understand and Remember Key Concepts</i>	In-Class <i>Analysing Key Concepts</i>	In-class <i>Applying Key Concepts</i>	Post –Class <i>Assessing higher order synthesis of Key Concepts</i>
Purpose	Define key concepts Identify relevance of topic Shift the workload from in class to preclass or post class. Embed interactivity/checkpoints for student feedback Analyse student responses to checkpoints prior to classtime	Report back on pre-class responses Address any salient areas identified in pre-class activity Provide teacher and peer feedback to the pre-class responses Work through Instructor guided examples on 'real world' applications Highlight relevance	Workshop authentic tasks in a real world or simulated context. Actively learn in a safe space Receive peer to peer and student to teacher feedback Prepare students for assessment Explicitly identify relevance to authentic applications	Apply key concepts to new situations within broader contexts Receive feedback on performance from peers and teacher Provide opportunity for students to reflect on further learning needs and devise improvement strategies
Examples and aligning technology to pedagogy	Short Reading Narrated PowerPoint Short lecture recording 7-10 min Audio/Video Articulate/Adobe Presenter (Interactive Learning Module) Discussion Board/Chat room Concept Map drawing	Case study/real life worked exemplars Team Based Learning (Assurance Testing) In class voting e.g., Plickers Simulation activities with instructor providing debrief	Real-world examples including: Case studies Student presentations Tutorials In class debate Simulation with student leading the debrief	Tutorial Assignment Field work Clinical Placements Report Writing Project work and research Written and/or oral exams

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