Clinical classrooms: reflections on the choice of technologies when creating a new blended learning experience

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This study analyses how technology supported the roll out of a new teaching approach for medical students, in order to improve engagement with traditional lecture content. A flipped classroom approach was implemented during the teaching of Infectious Diseases and Immunity using a modified Team Based Learning (TBL) learning design. Students first viewed a set of online lectures, followed by a face-to-face session called a Clinical Classroom. In the Clinical Classroom students participated in team based quizzes and discussions. Students were surveyed on six occasions to collect data on how this new approach helped their learning and staff reflected how their assumptions changed over the course of their teaching. Medical students generally valued having their lectures divided into smaller sections and placed online, followed by the clinical classroom. There were some limitations with the technology (such as lack of access to the questions after the class), which will be addressed in future iterations of the course.

Keywords: Flipped classroom, Team Based Learning (TBL), learning design, medicine

Introduction

Students in their first two years of their medical degree (Foundations of Medicine 1 & 2) at the University of Western Sydney (UWS) are presented with a variety of learning opportunities including: traditional lectures, problem based learning (PBL) tutorials, clinical skills tutorials, and anatomy and histopathology practicals. When we reflect on student engagement and participation in the different ways that we use face-to-face time with students, it becomes apparent that some students do not value the opportunity to come to lectures, with more and more students choosing to rely on the lecture recordings instead. This is frustrating for the lecturer who has to teach to an almost empty lecture room, and sends "mixed messages" about which teaching opportunities that the students value as a way to learn.

The forty or so lecturers that teach into the course come from clinical and research backgrounds and have a wealth of rich knowledge about the topics that they teach, yet spend the majority of their time teaching about basic, core concepts, rather than looking at how those concepts translate into a clinical setting. Therefore, reflection on the two issues described above, has led us to explore a pedagogical movement called the "flipped classroom" which promises to engage students in a more active learning style and makes better use of the lecturer's time when face-to-face with the students.

Flipped classrooms and Team Based Learning

In 2007, Jonathan Bergmann and Aaron Sams developed the "flipped classroom" instructional model to provide instruction to secondary students who were missing class and therefore missing instruction (Bergmann & Sams, 2012). In the flipped classroom model, direct instruction is done prior to class and is typically delivered online and then class time is used to engage the students in discussion which uses the teacher or lecturer's detailed knowledge of the topic to help talk the students through problem solving activities and other active learning strategies. While there are many school and university courses that are implementing this new teaching innovation (Hamdan, McKnight, McKnight & Arfstrom, 2013), there is still much to be learned about how the teaching of medicine can be enhanced in a 'flipped classroom' setting, particularly as there are so many different inputs that can affect the outcome (the number of different lecturers, timetabling, tutorials, technology, teaching spaces and student attitude).

Concurrent to the 'flipped classroom' movement, a growing number of medical schools are investigating a Team Based Learning (TBL) approach (Thompson *et al.,* 2007, Parmelee, Michaelsen, Cook & Hudes , 2012). TBL has many similarities to the flipped classroom approach but it a much more structured pedagogy. It can be used in large classes (>100 students) or smaller classes (<25 students), and incorporates multiple small groups in a single teaching space. TBL is characterised by students participating in a set sequence of activities:

- Preparation of a topic in advance by individual students,
- Individual and team readiness assurance tests (tRATs) and
- In-class time devoted to team work around problem solving

A great strength of this approach is that there is immediate feedback on both the individual and team performance so that students know "where they are" with respect to understanding the content rather than only finding out during an end of semester summative exam. The instructor also has continuous opportunity during the class to know how learners are grappling with the material.

Structure of the Infectious diseases and Immunology Block in Year 2

An ideal opportunity to trial a flipped classroom approach is when students are in their second year of their medical degree and have to learn about Infectious Diseases and Immunology over a six-week block of learning. To date, students have performed relatively poorly in this block because it is content dense and the students are confused about how to apply their learning to new patient case studies (that haven't been covered in their Problem Based Learning tutorials). Inspired by a visit to the Lee Kong Chian (LKC) School of Medicine, at the Nanyang Technological University, where TBL is being successfully used (Gagnon, 2013), we decided to try a modified version of TBL in our own "flipped classroom". We wanted to see if a more active style of learning would lead to better engagement and student understanding of this content. This paper seeks to explore how technology was used to support the implementation of this new blended learning approach and uses anonymous student surveys and teachers' perceptions to reflect on what we learned.

Materials and methods

Overall Learning Design for the Flipped Classrooms

Three lecturers, who teach the majority of the Infectious Diseases (ID) content of the block agreed to participate in the new teaching approach. All of their usual face-to-face lectures were pre-recorded and placed online. Students had to view a set number of lectures in preparation for a "clinical classroom" session where they were divided into groups of around 10 and given group readiness quizzes and case based discussion questions around clinical scenarios to help them understand the content that they had learned online (Figure 1). In total there were eight Clinical Classrooms, each on a different topic.
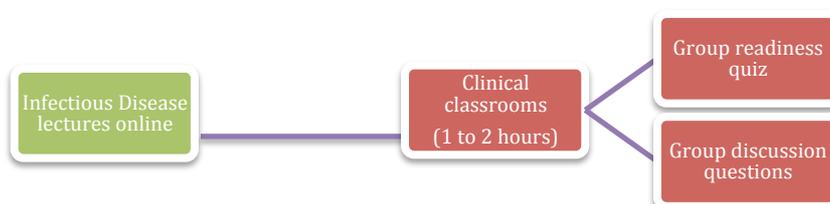

Figure 1. Learning design for Clinical Classroom

Online lectures
A total of 23 face-to-face lectures were replaced with pre-recorded lectures and placed online for students to use over the six weeks of the Infectious Disease and Immunology block. Lectures were recorded with Camtasia® to capture and edit the lecture. The previous year's 50-minute lectures were broken up into smaller topics, which ranged between 5 to 30 minutes. The lectures were then uploaded onto a shared

drive where the course administrator could upload them onto the university LMS (Blackboard) course site and arrange them into groups of content in preparation for the clinical classroom.

Group readiness quiz and case discussion questions (in Clinical Classroom)
All three staff involved in the project attended each Clinical Classroom session. This was to allow the staff to answer questions that were around in their own area of expertise. Students were divided into their Problem Based Learning tutorial groups and each group was assigned an area of the lecture theatre to sit in.

Together with the lecturer, each group then went through quizzes and discussion questions based on the online lectures that they were given in the lead up to the clinical classroom. NearPod, an interactive mobile presentation app, was used to deliver the quiz and discussion questions. The lecturers particularly requested to use this software as they felt it was easy to use and so would not be time consuming to implement. The perceived advantages of using NearPod included:

1. PowerPoint slides can be uploaded directly onto the app and then interactive elements, such as quizzes and discussion questions, can be slotted in to make the presentation more engaging.
2. The lecturer/instructor controls the student's screen so that they see only what the instructor wants them to.
3. The app can be used on a laptop (through an internet browser) or mobile devices (as a free downloadable app).
4. The instructor can see the student responses as they are submitted and can share a response for discussion with the whole class.

Only the chosen team leader of the group was logged in to NearPod and they were responsible for entering the team's answers. The NearPod screen was also projected at the front of the lecture theatre so that all students could easily see the information and questions. Clinical classrooms were not audio recorded.

Student evaluation of the technology used in Flipped Classrooms
Students were surveyed about the clinical classrooms and online lectures on six occasions as the new teaching strategy was implemented. Students were asked about the length, structure and content of the online lectures and the face-to-face sessions. They were invited to participate in the surveys at the start of some clinical classrooms and ethics approval to run the surveys was given by the UWS ethics committee (approval number H9989).

Staff evaluation of the technology used in Flipped Classrooms
The three staff involved in implementing the clinical classrooms met before; during and after the flipped classroom approach was implemented. The discussions were not recorded, but notes were taken. Questions included ease of use and limitations of the technology, the time taken to implement the online lectures and student engagement.

Findings

Student survey responses

Out of a possible 130 student responses, the number of responses to the student survey ranged from 54 in the first survey to 11 responses by the last survey. The data is a compilation of all responses across all six student surveys. The majority of students (~75%) were positive about using the online lectures for preparing for the clinical classrooms topic. The students were also generally positive (52.5%) or neutral (28.6%) about having online lectures instead of face-to-face lectures (Figure 2).
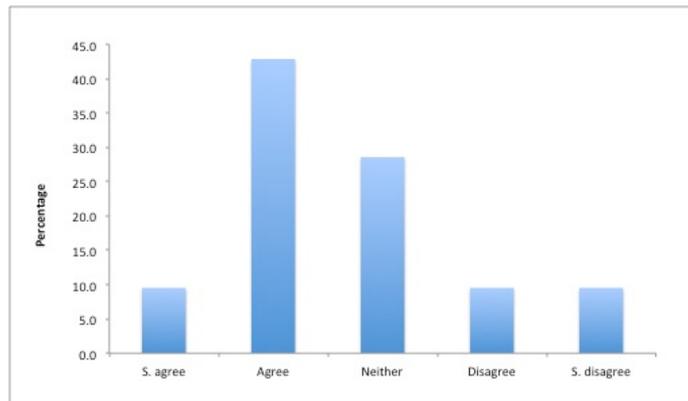
**Figure 2. Responses to "The online lectures were
preferable to face-to-face lectures on the same topic"**

The students were also very receptive to having the lectures divided into shorter topics (Figure 3) and made lots of positive comments about this aspect, such as:

Short lectures, easy to listen too

It was good that it was split up into little chunks of information

Short duration allows watching some in between other activities
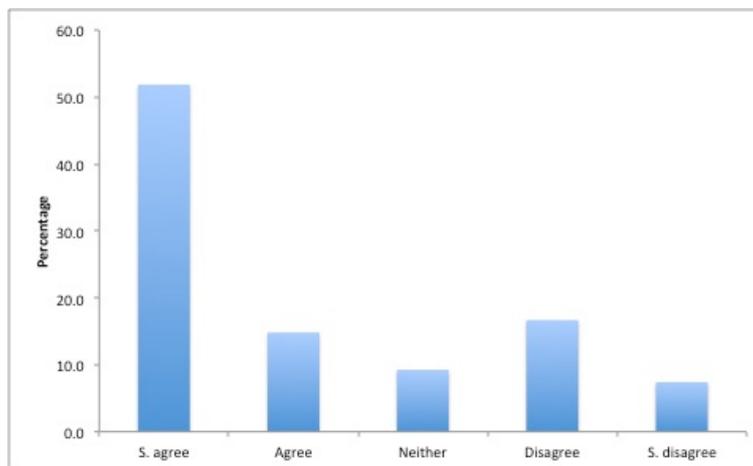
**Figure 3: "Making the online modules consist of small segments
was better than having it as a recording of an entire lecture"**

However, in contrast some students seemed irritated when the chunks of content were shorter in duration:

The ~approx 20 mins/30 slide lectures were good length, 5 min lectures seemed very short.

I think there are too many mini recordings- would prefer bigger chunks of info

10 minute modules are too short - 20-30 minutes would be better

When it came to the clinical classrooms, 49% of students indicated they would like more clinical classrooms in the future (and 30% neither agreed nor disagreed with adopting more clinical classroom). The main complaint was related to the students' inability to return to the NearPod session to look over the

questions and answers again as only the lecturer had the ability to return to the session after the class had finished (due to a limitation of the NearPod software, n.b. we were using a free version of NearPod):

> The answers and the lecture slides used on that day should be uploaded as that would be beneficial for review purposes.

> It would be more helpful if we had access to practise questions and answers at home to supplement the clinical classroom, because sometimes in the tutorial the answers to questions are skimmed over and I would like more time to revise the scenarios for exams

> Recording of the clinical classroom to be made available for later reference.

There was also discontent around only one student having control of the NearPod screen, a well as when the lecturer moved onto the next screen without sufficient warning:

> For future reference - one iPad for PBL group is too little for a whole group involvement

> Please give us more time to answer questions or give us warning when the questions are being taken down as sometimes we are in the middle of discussions when the questions are taken down

Teaching teams reflections

Time
The use of technology for teaching was an important topic among the issues discussed between the three ID lecturers. It was a time consuming process for the staff. The Prof of Infectious Diseases (main contributor of teaching content) kept a record of the time taken to meet about the clinical classrooms, prepare for and deliver the content and worked out that he had contributed over 200 hours to this project.

For every hour of online lecture that was recorded (and there was approximately 19 hours of recording) an extra 60 or more minutes was needed for the preparation of the lecture for recording (including dividing the lecture into smaller topics), uploading the recording and lecture slides to a shared drive, the download and then upload onto the university's LMS, and organisation into modules for students to use in preparation of the clinical classroom. In addition, the clinical classrooms were a completely new concept and hence required careful planning for their preparation. However, the time burden will be considerably less next year as the content can be reused (even with any potential modifications that are planned).

Software
The lecturers were generally content with using Camtasia to record their lectures and did not need to be taught how to use it. The only issue was around file size as the Blackboard site for the course had a limited size, which we quickly exceeded when we first started uploading the lectures. Changing the settings enabled us to make the files sizes considerably shorter.

NearPod was able to present the clinical classrooms to the students in an attractive format, and effectively delivered the quiz questions and open-ended questions for discussions. There was also some use of the drawing tool where students could label an image. Lecturers liked having control over the pace of the lesson by being able to control the students' screen. It took a while for the lecturers to feel comfortable with how the instructor screen was different to the student screen and to feel in control of what was visible. The lecturers commented that creating the clinical classrooms on NearPod wasn't as quick as they had hoped and there was some frustration that NearPod had made some updates to their software during their use, which had changed the look and feel unexpectedly.

Learning Design
A drawback with using NearPod was that the students could not return to the session at a later date and review their answers, or see the answers that other students had made. We were aware of this limitation at the start and debated whether this could be a strength as it would control who could see the session (e.g.

only the students who had come to the clinical classroom). However, we quickly realised that students could take screen shots of the content while they were in class and share it with other students. We decided that it is important for students to review their work for future study purposes after they had participated, and that this would be a desirable feature in the future.

The lecturers were reluctant to swap and change software in the middle of the clinical classroom, so the activities that students could do were limited to those available through NearPod. The lecturers mostly used quiz questions and open-ended questions which is an area that could be improved in the future to make the content more engaging. For example, students could use mind-mapping tools to analyse the pathophysiology of a disease.

The online modules and clinical classrooms combined took up more of the students' time than the lectures had taken in previous years (19 hours of online lectures plus 12 hours of clinical classrooms versus 23 hours of lectures in previous years). This was not the intention when this process started and a future iteration of the course will need to further refine the online lectures around core topics to make them shorter. In addition, instead of doing the group readiness quizzes in the clinical classrooms, the questions could be completed individually by the students online, leaving the more complex case discussions for the face-to-face session.

Student tracking
We also looked at how each of the chosen technologies was able to track the students' progress through the online content and clinical classrooms. Both Blackboard and NearPod have the ability to track what students have seen or done, but because the content was divided between these two platforms it was difficult to get a snap shot of how a student had progressed through the different stages of the flipped classroom, especially with only one student on behalf of each group accessing the NearPod session.

Discussion

The results of the surveys and discussion show that the technology that we used to implement the flipped classrooms (called Clinical Classrooms) was able to deliver the learning design as chosen but with some limitations. We made some assumptions about what was desirable about the technology and discovered that other attributes would be useful for future iterations of the flipped classrooms. In particular both the staff and students agreed that there should be better access to the content of the Clinical Classroom questions and answers that were completed using NearPod. While there is an option to pay for an upgraded version of NearPod which has more features, for example, the session can be run again as homework for the student to review in their own time, this feature does not allow the student to see how their peers are answering the questions, or save their questions from a previous session. Students also wanted to view the content on their own screen during the Clinical Classroom, not share one screen with their group.

There was strong support from the students to have their lectures online, and smaller chunks of content (but not too small) were appreciated. They would have liked there to be more interactive elements to the online lectures, such as quiz questions. They could then review their learning straight after watching the lecture and have more time to go over any misunderstandings. Moving the quizzes online would also shorten the face-to-face sessions which where quite intense when they went for 2 hours.

The lectures involved in teaching the Clinical Classrooms have accepted a proposal to use LAMS to run Clinical Classrooms as a possible future direction for this project. This would be a different way for us to use LAMS as we have never used it in a face-to-face session before. Certain features of LAMS make it appropriate for our goals, such as:

- sequencing of video and questions in one place,
- a record of student answers that are accessible after the student session,
- the ability to track the students progress through all of the activities,
- the ability for groups of students to chose a representative "leader" to answer questions, while still being able to participate in the activities,
- the ability to use other activities such as mind-mapping and
- the ability to branch the different groups into different activities.

However there are disadvantages; lecturers would not be able to upload PowerPoint presentations straight into LAMS for delivery in the style of NearPod and they would not be able to control the pace (via control of the student screen) of the lesson as easily. An example of how this learning design might look in LAMS has been uploaded into the LAMS community (www.lamscommunity.org) to act as a 'talking point' for the flipped classroom learning design in the context of a medical course. It has allowed discussion and reflection about how the flipped classroom approach might work next year, even if LAMS is not necessarily used in the future. For a visual representation of the Learning Design in LAMS see Figure 4 or preview the sequence at: http://lamscommunity.org/lamscentral/sequence?seq_id=1874669
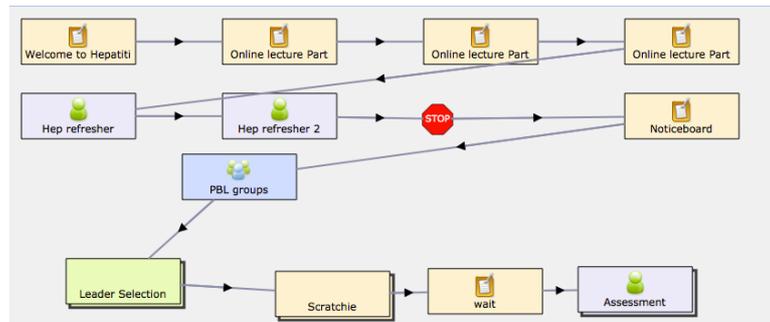
Figure 4: LAMS sequence showing a visual representation of a Clinical Classroom learning design

In summary the majority of students surveyed liked having lectures online and the chance to generate, test and regenerate their knowledge in a face-to-face session. However, a key requirement of the future will be for students to be able to access the content and their answers again after the Clinical Classroom, as well as for each student to be able to view the content on their own screen during the Clinical Classroom while still having a leader for their team.

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