PEDAGOGIC DIRECTION

Making 'The Flip' Work: Barriers to and Implementation Strategies for Introducing Flipped Teaching Methods into Traditional Higher Education Courses

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Abstract

This article describes strategies used by the author to introduce a flipped teaching approach into a traditional course taught at a UK higher education institution. Traditional live lectures are replaced by video screencasts to be viewed outside the classroom by the students. Lecturer–student contact time is used for interactive workshop activities aimed at facilitating deeper conceptual understanding of the subject material. Changing to a flipped student-centric approach from the more traditional lecturer-centric approach can be challenging for both student and lecturer alike. This article describes such an attempt in modules for 2nd and 4th Year chemistry undergraduates. Student surveys show that the vast majority of students are quite positive about the flipped approach and prefer it to the traditional delivery. Based on the receptive nature of the student response and the greater opportunity for developing higher learning skills afforded by this approach, we believe it should be more widely adopted in the teaching of the physical sciences in UK higher education.

Keywords: flipped classroom, screencasting, higher learning, tablet computing

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Introduction

Traditional physical science courses at UK higher education institutions are lecture-centred with this mode of didactic teaching dominating the student–lecturer contact time. While the lecture originated in medieval times as a method of transferring information and knowledge, it has persisted to this day in spite of the major technological developments in information transfer that have occurred in the intervening years. This is at odds with much pedagogic research which debates the learning, if any, that takes place in the formal lecture setting and poses the question whether teacher–student contact time could be used more productively (www.brookes.ac.uk/services/ocsld/resources/20reasons.html, Bligh 1972).

The suitability of the didactic lecture format for teaching and learning has recently been challenged by the proliferation of flipped or inverted teaching methods originating from high schools in the USA (for reviews, see Bergmann & Sams 2012, www.flippedclassroom.org). The flipped teaching method essentially reverses the traditional teaching model, in which students are instructed via lectures during the student–teacher contact time. In their own time students review the material covered in class and use problem-solving or other exercises to further probe and understand the presented material. Student–teacher contact time is used for transferring knowledge from teacher to pupil while the student is left essentially alone to grapple with understanding and further comprehension and application of the information given.

The flipped model inverts this process. Transmission of the required information takes place outside of class without any direct face-to-face teacher–student contact, while the development of the student's comprehension is carried out in the teacher's presence via interactive problem-solving sessions or use of personal response systems. The advantages of this approach are that the teacher–student contact time is used to develop the students' understanding of the topic. Students can progress at variable rates depending on their comprehension of the topic at hand and specific student problems can be directly addressed by the teacher.

In the flipped teaching model transmission of information can be performed in a number of ways. Assigned reading can be carried out before class and in certain cases the comprehension of this material can be surveyed before class to target areas for further development during student–teacher contact time. Increasingly, prior content is delivered via video presentations. These can be presentations from outside teachers which are becoming increasingly available via open educational resources or sites such as iTunes and YouTube. Alternatively, video presentations can be prepared by the teacher for viewing by the students prior to class. Developments in screencasting in recent years have made such technology both easily available and user-friendly thereby opening up applications for most teachers. This is the approach used in this implementation.

In this article we describe how we have implemented aspects of the flipped classroom into a 2nd Year and a final year module in the School of Chemistry at the University of Manchester. We outline the methods applied, the barriers encountered and the reaction of students to this change in teaching practice.

Technical aspects

Tablet PC

The Tablet PC is equipped with a pen that can be used to write or draw on the laptop screen using digital ink. The Tablet PC used by the author is a convertible Tablet in which the screen can be rotated to convert from a normal laptop to a flat screen for writing purposes. Digital ink is available in a variety of colours and can be easily modified or erased (see Figure 1). While initially it can be difficult to write clearly on a computer screen, it is similar to writing on an overhead projector and with practice the author has found that he can write more clearly on the Tablet than on paper. In addition, a variety of writing styles and colours is available simply by clicking on an icon using freely available software programs such as Microsoft Journal or OneNote (see www.flippedclassroom.org).

Screencasting

Screencasts are a digital video recording of your computer screen activity and usually include synchronised audio commentary. Essentially they are equivalent to letting somebody look over your shoulder to view your on-screen activity while you provide a running commentary (O'Malley 2010, 2011). You can limit the recording to a specific program (e.g. a Word document) or you can define the part of the screen that you wish to be recorded. You can also record a web camera image of yourself to accompany your presentation. There are a number of software products, both freeware and commercial, that allow you to record screencasts. The most popular, and the one used in this work, is Camtasia Studio. The screencasts were made available via the university VLE, Blackboard.

Methodology

Chem 20050 is a 10-credit course that covers mathematics for chemistry for 2nd Year BSc and

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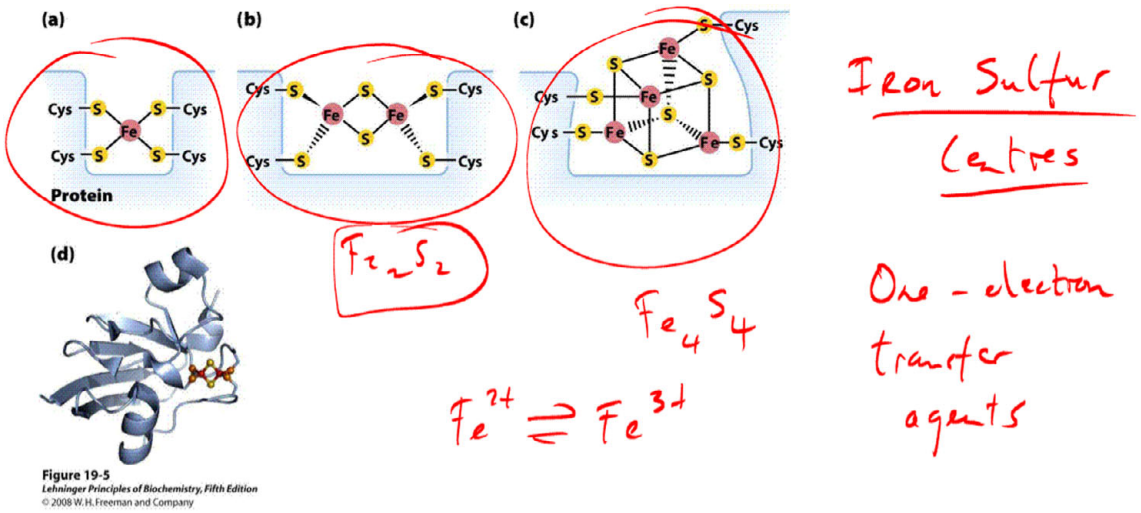

Figure 1 Page of notes from screencast used in Chem40261 module.

MChem students at the University of Manchester. Its objective is to cover the mathematical content required to satisfactorily complete 2nd, 3rd and 4th Year courses in physical chemistry and related disciplines. Topics covered include advanced calculus, coordinate geometry, vectors, complex numbers and matrices all with chemistry related applications emphasised. It was decided in 2011 to deliver this course using a flipped teaching method. The content was divided up and presented in short screencasts lasting from 20 to 40 minutes. The screencasts were produced on a Tablet PC as this allows for interactive writing on the computer, which is particularly well suited for mathematical content delivery compared with static pre-prepared PowerPoint slides. Each week problem-based exercises relating to the week's topic were distributed to the students. Students were encouraged to attempt the problems in their own time and a clinic/workshop was run each week to help them with any problem areas they were encountering. A discussion forum on Blackboard was also set up to allow students to discuss problems online. Based on the comments received online or at the clinics a screencast of solutions to the previous week's problems was prepared and distributed to the students via Blackboard. This procedure ran for a total of one full semester. Students were required to sit an examination at the end of the course and the marks contributed towards their overall average for their second year.

Chem40261 is a final year 10-credit MChem module on Biophysical Chemistry. It is an optional course and in the academic year 2012/13 was taken by 52 students. One of the authors of this article, Patrick O'Malley, was one of three lecturers teaching the full semester course covering the topic of bioenergetics. This section of the module had been previously taught in a traditional eight-lecture format with one tutorial until it was decided to change the format to a flipped version. After the first meeting, where the format was explained, all other face-to-face sessions involved workshop problem-solving activities or clicker sessions. No formal traditional style lectures were delivered. All of the content was delivered using screencast presentations, which were made available each week to the students via our virtual learning environment Blackboard. A discussion forum was also set up on Blackboard to facilitate online interaction between the students. For each workshop/interactive session a summary screencast was prepared which covered any difficulties that were apparent from the online forum or at the interactive session itself. As this was quite a departure for 4th year students more accustomed to a traditional lecture format instruction, any requests there might be to revert to the more traditional format were solicited early on. None were forthcoming and generally positive comments were received for the flipped format (see below). Attendance was rarely above 70% at the interactive session but this was similar to what would be expected for the traditional lecture. In probing reasons for non-attendance the most common reply was that the students had already grasped the material from the online screencasts. This was judged unsatisfactory, however, as the interactive sessions are meant to facilitate deeper learning, a point that is sometimes not appreciated by the students. To encourage participation in the interactive sessions, a small assessed element at the end of the workshop was introduced, which contributes a small proportion to the final exam mark. This led to a significant increase in participation at the interactive sessions and will be expanded in future years.

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Student feedback

Students were surveyed as to the suitability of this teaching format and were asked to compare it with the more traditional live-lecture methods of instruction by answering either 'Yes' or 'No' to the following question:

> ***"Do you believe the flipped teaching method used in this module is better than the traditional lecture-based method?"***

For Chem20500, there was a response rate of 63% of whom 74% answered 'Yes'; for Chem 40261, there was a response rate of 49% of whom 85% answered 'Yes'.

The students were also invited to provide reasons for their answer. By those answering 'Yes' to the above question, a number of illuminating reasons were provided:

> ***"Often need to ask more questions when working through tutorials/workshops than during lectures so is better to watch lectures in own time and having a recording to watch pause and rewind during revision was very helpful!"***

> ***"It seems like a much more sensible medium of teaching and it makes sense to use lecture time for workshops. It was also very useful during revision to look at a specific slide being discussed multiple times. I guess there might be problems persuading people to turn up to the workshops but that's their own loss."***

> ***"I do think that the flip teaching method would only be suitable for 4th years and perhaps 3rd years as well. The reason being, it requires the student to put in independent learning hours. This needs to be effective as the material will be new to the students and not just revision. I think 1st and 2nd years will find it difficult."***

> ***"The increased number of exercises, when compared to traditional lectures, is very beneficial."***

> ***"For this course at least, because it allows people to go through at their own pace. Traditional lectures cannot be paused or rewound to repeat a difficult to grasp point, and by the same token they cannot be largely skipped over to find an explanation to a single issue in a concept that is otherwise thoroughly understood."***

> ***"It allows us to apply our knowledge to ensure we understand it in context. The video lectures were great if we had missed something you had said; however, they should have all [been] carried out in the allocated lecture time slots, not in our own time for the first time as we could not ask questions to clarify the material. If there was less lecture material, as well as the workshops in the 8 slots, I feel we would have got just as much out of it. In general, a great course."***

> ***"We could follow the lectures at our own pace, which I think is better, because it can be fit [sic] around my personal timetable, rather than having a set lecture that I may or may not be able to attend."***

For those answering 'No' to the question above, typical reasons provided were:

> ***"It is more engaging to be in a live lecture as well as being able to ask questions. However, a mixture of the two would give the best results as with flipped teaching you can cover the lecture in your own time with no pressure."***

> ***"I found it extremely difficult and irritating to follow the 'screencasts' as I found the areas I find easiest were taught slowly and the sections I had difficulty with were taught too quickly."***

> ***"I believe that the 'flipped teaching' method is not better than traditional teaching methods for this course. I think that a lecture engages students more and allows you the opportunity to ask questions in a lecture environment, where other students can also take note of the answer. Personally, I find it much easier, for want of a better word, to learn through being spoken to in a lecture, rather than being left alone to work it out."***

Discussion and summary

Based on this student survey the 'flipped teaching method' has been well received by a sample of second year and final year MChem students used to being taught in the more traditional lecture-style format. A similar finding using a different approach has recently been reported by Lancaster (2013). The key advantages usually advanced in favour of the flipped teaching method, such as flexibility, learning at one's own pace, and being student-centric, are all supported by student responses to our survey. While there is clearly a minority of students who favour a more traditional teaching approach, the vast majority of the cohort of students surveyed here were significantly in favour of the flipped

approach. This finding is somewhat surprising as the second year cohort have been subjected to traditional lecture format teaching for a year and the 4th year MChem group have had traditional lecture-based teaching for three years.

While the flipped format of teaching and learning was favoured, one worrying aspect was the lack of evidence that the students fully appreciated the opportunity afforded by the face-to-face interactive sessions to facilitate deeper and higher learning skills. Based on the student responses, the main appreciation came from the increased flexibility afforded. There is a tendency for some students to regard workshop attendance as optional as there is a perception that complete learning can be achieved by viewing the content screencasts alone. This is probably a throwback to the students' perception of what learning is in the traditional method, i.e. the students perceive the screencast format as simply a more flexible method of receiving information than the live lecture. While adopting this method initially, it is important to emphasise to students the added-value component of the interactive face-to-face sessions. This may well be aided by providing an initial incentive for students to attend these sessions. In this case it was agreed that a short test would take place at the end of each workshop session which would contribute a small percentage mark to the final exam. This was found to provide the incentive to attend the interactive session initially and allow the students the opportunity to appreciate the beneficial aspects of these to aid higher learning skills.

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