

Using Echo360 Personal Capture software to create a 'flipped' classroom for Microbiology laboratory classes

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Educators are under increasing pressure to engage with students that have grown up with digital technology. The 'flipped' classroom utilises digital technology, usually pre-recorded lectures, to free class time from lecture by assigning students with preparatory instructional content as homework. This model is often used successfully in lecture based classes and is finding increasing adoption in laboratory settings. In this study we employed digital educational technology and applied the 'flipped' model in microbiology laboratory classes. Echo360 personal capture software was used to prepare introductory lectures for students to use in preparation for laboratory classes. The built-in analytics of Echo360 were used to quantitatively monitor student usage. More than half the class engaged with the lectures and used them for their intended purpose, i.e. preparation. Students did not engage with the lectures to the same degree for revision purposes. No correlation was found between student lecture usage and their exam grade.

Keywords: Echo360, flipped, usage, microbiology, laboratory class, views, course statistics

Introduction

Hands-on laboratory and/or practical classes are considered the defining characteristics of science courses (Mawn, et al., 2011) and, by definition, "practical skills have to be acquired through experience" (Waldorp, 2013. p.1). A traditional model for the development of technical skills and procedural fluidity in many science disciplines is employed at the University of Tasmania, with experiential learning undertaken in laboratory classes. This is particularly so for a second year undergraduate microbiology class which is delivered with face-to-face, weekly, intensive, three-hour practical classes. While the theory component of the unit has a strong online presence, namely lecture capture, pre-laboratory exercises and quizzes, the laboratory classes offer a stark contrast. The laboratory classes are delivered face-to-face only and include a 20-25 minute introductory lecture that summarises the key points for the class. The remainder of class time is allocated for completing the required projects as either individuals, pairs or a bench of four. Although student feedback has been positive regarding the inclusion of the introductory lecture-style briefings, many students found their inclusion negatively impacting on the time available to complete tasks and collaborate with peers. A new strategy for these introductory lectures was required to address student feedback and the 'flipped' classroom identified as a potential solution.

Educators are under increasing pressure to improve learning experiences and capture the attention of a generation of students that have grown up with readily accessible digital technology (Bunce, Flens & Neiles, 2010). Students today are considered "digital natives" and often prefer graphics before text and have a decreased tolerance for lecture-style dissemination of course information (Prensky, 2001). The 'flipped' classroom and learning models that blend online and in-class learning are a strategic direction that assists higher education by using readily available digital technology to meet the expectations of today's students (Center for Digital Education, 2012). 'Flipped' or inverted classrooms use digital technology, usually in the form of pre-recorded lectures, to free class time from lecture by assigning students with instructional content as homework in preparation for class. Flipping the classroom to free class time offers students potentially more time for skill development and they are thus more effectively engaged in active learning of relevant discipline concepts. More class time means students will benefit from an increased opportunity for teacher-to-student mentoring and peer-to-peer collaboration (Hamdan, et al., 2013; Roehl, et al., 2013). Other benefits from compilation of a continuously available digital resource include the ability for students to access material at their own pace and in their own time, as well as the opportunity to revisit content repeatedly to either revise, reinforce key concepts or spend more time with problematic content (Lie & Cano, 2001; Fei et al. 2013).

The 'flipped' classroom learning model had its genesis in the traditional classroom setting but is now finding increasing adoption and utility in laboratory classes. The laboratory presents a unique challenge for technology integration as its requirements differ from that of a traditional classroom setting. In many cases laboratory classes are delivered via a laboratory manual containing detailed instructions and in a setting that has largely remained unchanged since the advent of digital technology (Caron, 2011).

This paper presents findings for a project that assessed the efficacy of the 'flipped' classroom model for the laboratory component of a second year microbiology subject at the University of Tasmania. Echo360 Personal Capture (PCAP) was used to prepare a series of pre-recorded introductory lectures and made available to students prior to undertaking the laboratory class. Echo360 analytics were used to record the usage of PCAPs by students and to investigate the relationship between usage and performance.

Methodology

Study cohort and selection of classes for 'flipping'

A second year microbiology class of 96 students took part in the project for one semester (13 weeks). Laboratory classes were divided into a Bacteriology Block (8 weeks), a Specialisation Block for Marine or Medical content (3 weeks), a revision class (1 week) and a practical exam (1 week). Prior to the project, introductory lecture-style briefings in the form of either PowerPoint presentations or Whiteboard presentations were delivered in class time at the beginning of the laboratory class. The Bacteriology Block was identified as most suitable for 'flipping' as all introductory lectures are delivered by the same instructor and comprise PowerPoint presentations rich in text, images and video content. Seven classes in the Bacteriology Block were selected for 'flipping'. The first week of laboratory classes was not suitable for 'flipping' as important safety information was introduced in the class and it was critical that students be inducted into generic laboratory protocols *in situ*. A total of eight lectures were pre-recorded, with six constituting 'flipped' Introductory Laboratory lectures considered as essential viewing in preparation for six laboratory classes (Weeks 2-7 of semester). The latter two lectures were optional viewing as they related to review material and a computer-based assessment task that could be completed by consulting the laboratory manual and/or viewing the lectures.

Echo360 Personal Capture and Usage Statistics

Existing PowerPoint content was enriched with laboratory specific movie files for microbiology procedures and web links to generic laboratory techniques. Narrative was scripted and the introductory lecture for each class was recorded using desktop PCAP. PCAPs were posted online five days before each laboratory class. Students were provided a detailed information sheet in their first laboratory class, which outlined the usual steps required to prepare for the following laboratory classes, i.e. reading the practical class schedule, introductions and procedures for specific projects and completing aligned weekly assessment tasks, as well as the newly prepared PCAPs which were intended for viewing as preparation.

A variety of data can be accessed through the EchoCenter interface. Course Statistics provide a 'snapshot' of viewing trends either 'by week' or 'by Echo' (i.e. PCAP). For each type of data set there is information on the number of:

- Unique Views - the number of different PCAPs viewed by each user.
- Cumulative Views - the total number of times a PCAP was viewed by users.

For both parameters a higher number is indicative of higher engagement by students. Usage Reports provided either aggregate data for each PCAP, including number of unique and cumulative views and completion time, or specific data for each student which records their engagement with a particular PCAP including completion percentage, total minutes viewed and number of downloads. The Viewing Analytics tool provides information for each PCAP, number of unique and cumulative views, as well as the average percentage of completion. An excellent guide for interpreting Echo Course Statistics has been prepared by Emory University (2013).

For this study Echo360 usage reports were exported from the EchoCenter to an Excel spreadsheet weekly immediately after each laboratory class. Data presented through Viewing Analytics was recorded weekly for each PCAP recording. While the essential pre-recorded lectures were intended for use as a preparation tool by students, usage data were also collected at the end of the semester to investigate usage by students as a revision tool for the final week's practical exam. Further, these data allowed us to investigate any possible correlations between PCAP usage and student performance in the final practical exam.

Results and discussion

Data for the number of Unique Views by students for each PCAP are presented in Figure 1. The data are separated into the number of Unique Views as preparation for the laboratory class, i.e. viewed before the class for that week, and as the total number of Unique Views prior to the practical Exam and representing the amount of access for revision purposes. The intention of the PCAPs was to ‘flip’ a component of the course to free laboratory class time from lecture by providing students with instructional content prior to the class. Figure 1 reveals that adoption of the ‘flipped’ classroom model was successful, with more than half of the 96 students accessing the essential PCAPs prior to the class. From weeks 2 through 7, on average 55% of students accessed the PCAPs in preparation for laboratory classes (range 49-61%). Viewing of an optional PCAP related to an assessment task was similar, with 51% of students accessing the tutorial. Far fewer students, 10%, accessed the small 9-minute PCAP that was devoted to review of results of the previous class. The number of Unique Views of the PCAPs for the ‘flipped’ component remains consistent, despite that students received reminders to view the PCAPs by email and through an online News tool immediately prior to weeks 3, 6 and 7. It is unclear whether those who viewed the PCAPs were a committed group who consistently viewed the lectures in preparation, an increasing number of students who viewed fewer PCAPs, or that there was a balanced influx and efflux of viewers during those weeks.

One proposed benefit of the ‘flipped’ classroom model is provision of readily accessible material for revision purposes (Herreid & Schiller, 2013). Figure 1 shows that PCAPs were viewed mainly as a preparation tool and not for revision as the number of Unique Views of each PCAP at the end of semester, and immediately prior to the practical exam, showed only a minor increase in the range of 6-9 views. Similarly the tutorial linked to an assessment task shows only a minor increase. The PCAP containing review content for the Week 7 class is the exception, however, with the number of views more than doubling by the end of the semester. However, much of this increase occurred in the week immediately post laboratory class and coincided with the computer based assessment task, possibly indicating that the spike was due to associated computer engagement.

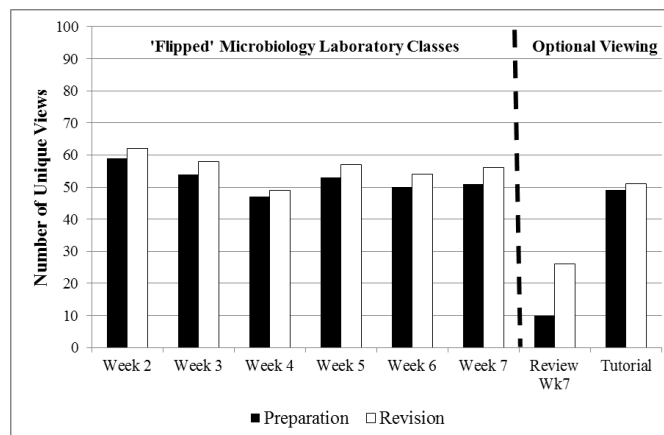


Figure 1: Number of Unique Views of all PCAPs

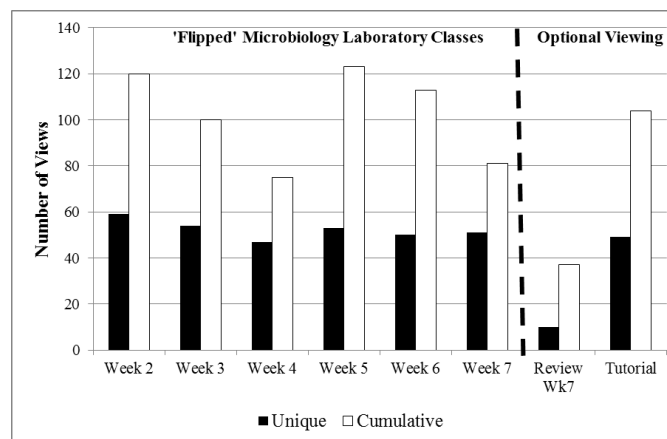


Figure 2: Number of Unique and Cumulative Views

The ability to continuously access a resource is a perceived benefit in any classroom (Heafner, 2004; Lie & Cano, 2001). Using the Course Statistics function, it is possible to rapidly determine whether students accessed a PCAP in a single sitting or whether they viewed it multiple times. Figure 2 presents the Course Statistics for each PCAP in this study. In all cases the number of Cumulative Views was higher than that of the Unique Views, indicating that students repeatedly accessed this resource. This may indicate that the format of the lectures was conducive to students either viewing PCAPs multiple times for particular areas they were interested in or had doubts with, or viewing them methodically in portions.

Aggregate data from the Usage Report allowed us to investigate whether there was a relationship between PCAP usage and performance in the practical exam. The average percent completion of PCAPs for each student was plotted against their practical exam grade (Figure 3). The data were grouped according to the number of Unique Views undertaken by each student. Simple linear regression reveals that there is no correlation between performance in the practical exam and engagement with the PCAPs with the regression model only accounting for 1.0% of the variance of the data. Thus, students who viewed more content in the PCAPs did not necessarily achieve a higher grade than students who viewed only a small component of recordings. There appears to be a relationship between the number of Unique Views undertaken by a student and the completion rate of PCAP viewings, with students who accessed more recordings likely to view more content of those recordings.

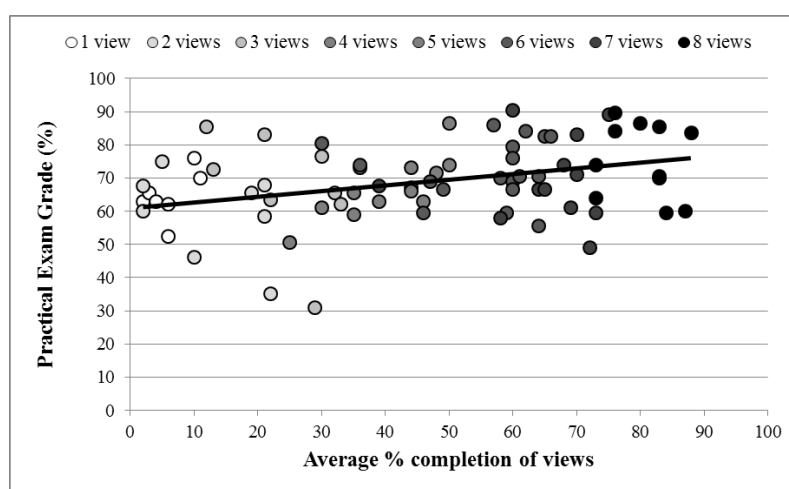


Figure 3: The relationship between student grade and PCAP view completion. The line of best fit for all data is described by $y = 0.1474x + 62.114$ ($R^2 = 0.1011$)

This project has allowed us to establish a base-line for adoption of PCAPs by students in microbiology laboratory classes. More data will be required to determine if 51% usage is a low, medium or high rate of adoption. We can, however, anecdotally report many benefits of ‘flipping’ the laboratory classes. The laboratory seats four students to a bench and we can therefore reasonably suggest that two of four students have accessed PCAPs and were prepared for class and ready to start work immediately. We observed that this occurred and that there was with a noticeably higher level of peer-to-peer collaboration than for previous years. Students who had clearly viewed PCAPs adopted a leadership role for those who had not. Further, there was a concomitant decrease in the amount of time taken to complete projects. In previous years all three hours of class time was utilised, with some students not completing all tasks. ‘Flipping’ the class resulted in student completion of all tasks and on all occasions exiting the class with time to spare. Finally, there was a noticeable decrease in procedural based questions asked of teaching staff and an increase in queries related to microbiology concepts. This could be the result of increased student preparedness or increased engagement by teaching staff who were reinvigorated by the ‘flipped’ initiative.

Conclusion

Echo360 personal capture was successfully used to pre-record lectures and ‘flip’ a component of an undergraduate microbiology laboratory class. Echo360 Analytics tools allowed us to monitor student usage and engagement with the ‘flipped’ lectures. More than half of students accessed the ‘flipped’ lectures in preparation for class, but students were less likely to use them for revision. No correlation was observed between students with a high level of engagement with the ‘flipped’ lectures and their grade in the practical exam. ‘Flipping’ the laboratory classes benefited students, and teaching staff, by allowing more class time to focus on skill

development, increased opportunities for student collaboration and improved interactions with teaching staff.

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