Student Perceptions of Flipped Learning

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Abstract

Flipped learning has been the subject of significant hype and attention but descriptions of the development and the evaluation of this pedagogical model are lacking. Flipped learning is an inverted teaching approach where students learn the basics via short videos at home, then come to class to complete challenges and clarify any misunderstandings. This paper describes how an IT unit was delivered using the flipped learning approach. A survey was used to determine how students perceived flipped learning. Students were generally positive about the approach, particularly the convenience and flexibility of the flipped videos. Although face to face teaching time was reduced in this flipped learning implementation, students felt that they interacted more with their instructors and peers. Students felt strongly positive to walkthroughs and were mixed as to the need for the instructors face. Significant efforts to produce high quality and engaging videos were made, but the survey suggested that students learnt the most during tutorial time. The relative importance of interactive tutorials is congruent with a large body of research and pedagogical approaches advocating the importance of active student-centred learning.

Keywords: Flipped learning, student-centred learning, inverted classroom, online learning, blended learning, IT education

1   Introduction

The flipped classroom pedagogical approach generally involves inverting the typical university style of lecture-based teaching, to get students to view short video lectures at home before the class session, and reserving class time for more interactive activities such as discussions, group exercises or projects. This approach has received a lot of publicity, but there has been little formal evaluation of the impacts on student satisfaction or performance. There has also been little research on how the pedagogical approach can be used in teaching Information Technology (IT).

This paper seeks to address this gap by describing the development and evaluation of a new flipped classroom IT unit called Introduction to Server Environments and Architectures (ISEA). The evaluation was performed to determine student perceptions of

the efficacy of flipped learning. Content, accessibility, the amount of face-to-face interaction and preference on video types were all specific areas of interest. The results provide insight into the value of adopting a flipped classroom approach to teaching in IT, and provide understanding about the contribution of different aspects of the design to student satisfaction with their learning.

This paper is structured as follows. Section 2 reviews the literature of online learning, flipped learning and other similar pedagogical approaches. Section 3 describes the unit and the approach taken to create and deliver the videos. The method for the evaluation is detailed in Section 4 and 5 discusses the results. Section 6 concludes the paper.

2   Literature Review

Online learning has received significant attention in the past decade, with increasing amounts of tertiary instruction being delivered online. There are various pedagogical models that can be used to facilitate online instruction. Some courses are delivered purely online, with no face to face interaction. Blended learning is a broad term and simply refers to any learning program where more than one delivery mode is used. Within blended learning, numerous different pedagogical approaches exist including student-centred learning, active learning and problem based learning. Flipped classrooms (AKA inverted classrooms) are one way of implementing active student-centred learning. Flipped learning inverts the traditional approach of teaching the basics in class and reserving practical activities for homework. In flipped learning, the basics are covered in short video lectures which are watched before attending class. This reserves class time for interesting and engaging problem based learning. Any difficulties with the basics can also be identified and addressed during class time.

Flipped learning has received a great deal of popular attention, particularly due to the success of the Khan Academy, which offers a library of over 3,000 videos. The creator, Salman Khan, has been a strong advocate of the flipped learning model.

Despite the flipped learning hype, there is very little evidence about the specific merits of flipped learning and there have been calls for quantitative and rigorous qualitative research on flipped learning (Hamdan 2013, Bishop 2013). In their review of the research on flipped learning, Bishop and Verleger (2013) identified 11 previous studies that have explored student perceptions of flipped learning and concluded that although the results were mixed, with a small proportion of students disliking the approach, students generally had positive perceptions of flipped learning. More recent studies by Butt (2014) and

Kong (2014) have also reported positive student perceptions.

Evidence on the ability of flipped classroom approaches to improve learning outcomes is more limited, but despite this, many of the elements are based on established and well researched learning strategies. The reduced emphasis on traditional lectures is supported by the literature, with a recent meta-analysis of 225 active learning studies in Science Technology and Math (STEM), finding that average examination scores improved by 6% and that students in traditional lecturing classrooms were 1.5 times more likely to fail (Freeman 2014).

Pierce et al (2012) used flipped learning in their pharmacotherapy class and found modest improvements in student performance as well as positive student perceptions that suggested that students recognised the pedagogical benefits and the convenience of the flipped classroom approach. Kong (2014) used a flipped classroom approach in an integrated humanities class and found that students taught in this way significantly increased their domain knowledge.

Within the domain of IT learning and teaching there have only been a limited number of published studies on the success of flipped classroom approaches to teaching IT. Gannod, Burge and Helmick (2008) described on a pilot implementation of a service oriented architecture course which was received very favourably by students. Both Day and Foley (2006) and Davies, Dean and Ball (2013) have taken their evaluation further and reported on learning outcomes. Day and Foley (2006) implemented a flipped classroom intervention for a computer interaction course and found that those students in the flipped classroom group received significantly higher results on both assignments and tests. More recently, Davies, Dean and Ball (2013) also noted improvements in learning for students in the flipped classroom version of a spreadsheet course. They however, identified the short duration of their class (5 weeks) as a limitation and called for further research on the use the flipped classroom approach in IT teaching.

3 Description of the Study

3.1 Information about the unit

A flipped learning approach was used in a first-year first-semester university unit called Introduction to Server Environments and Architectures (ISEA) at Murdoch University. There were 85 enrolled students, of which, 75 were enrolled in internal mode and 10 were enrolled in external mode. This unit introduces students to Linux and Windows operating systems, with an emphasis on servers. The unit also covers virtualization and Amazon EC2 is used as a vehicle to explore cloud computing. The final assignment task involves launching a Linux server in the cloud, linking it to Domain Name System (DNS) and installing/customising a server application such as HTTP. ISEA was a new unit and ran for the first time in Semester 1 2014. As a result comparisons with a traditional, non-flipped version, are not possible.

The familiar activities which accompany many university units were used. A unit guide dictated assessment and the breakdown of topics. A brief abstract was provided to introduce each weekly topic and tie the video, reading, discussion and lab elements together as a cohesive unit. All the elements required for the course were provided as links from the Learning Management System (LMS). Many of the units at the university have a 2 hour lecture and

2 hour tutorial format. In ISEA there was an introductory lecture in week 1, to describe the flipped learning approach, then all subsequent content was delivered online using short 3-20 minute videos.

In flipped learning, the tutorials are designed to be interactive and build upon the basics established in the videos. The ISEA tutorials began with a 20 minute discussion about something topical relating to the unit or the recent videos. While group discussions are the norm in arts degrees, they are rare for applied and technically focused IT units. Following the 20 minute discussions, students completed practical work which built upon the weekly videos.

3.2 Flipped Video Production

When converting a university unit to flipped learning, the new element required for the course is the short videos. The creation and production of these videos is likely to be the most time consuming element for unit coordinators.

3.2.1 Audio

An early decision was made to pursue quality audio in presentations. PCs, tablets and smartphones are all capable of high quality audio, while video quality is heavily dependent on the student's viewing platform, with small screen mobile devices severely limiting the effectiveness of a visual message. The unit coordinators purchased a popular USB omindirectional microphone and a broadcast quality directional microphone. Both were capable of quality audio but their characteristics and usage were quite different.

The USB microphone was suited to presentations where the presenter needs to move around as its positioning was not critical. It also made video presentations more casual as the microphone could be placed inconspicuously. The downside to the USB microphone's ability to capture audio from any position was its susceptibility to picking up background noise. Conversely the broadcast microphone was insensitive to background noise but required positioning in a manner often seen with radio announcers. This made it suitable for "voice-overs" but more difficult to use inconspicuously when combined with video of the presenter's face. Achieving clear audio is not difficult but each technology is optimised for particular conditions and matching the equipment characteristics to the environment was something we found to be important but not obvious at the outset.

3.2.2 Video

A variety of video capture methods were employed. These ranged from basic screen capture applications such as the open source "simplescreenrecorder" and "CaptureMyDesktop" which were used for demonstrating computer based activities and "walk-throughs" of screen based activities. An example of this video type is shown in Figure 1. The 'chalk and talk' approach, where the instructor talked the students through an idea while drawing a diagram or doing some math, was also used. This presentation type is shown in Figure 2 and is similar to the video type used on Khan Academy.

These videos were the most simple to produce as the steps used to combine the video and voice-over are flexible. Both can be captured at once and easily edited later. Alternatively a perfect run-through can be obtained first and then the voice-over can be added later, while the presenter watches the prerecorded action. For instructors seeking to record their
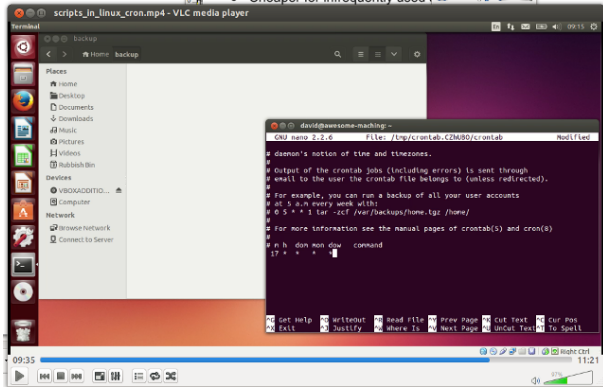
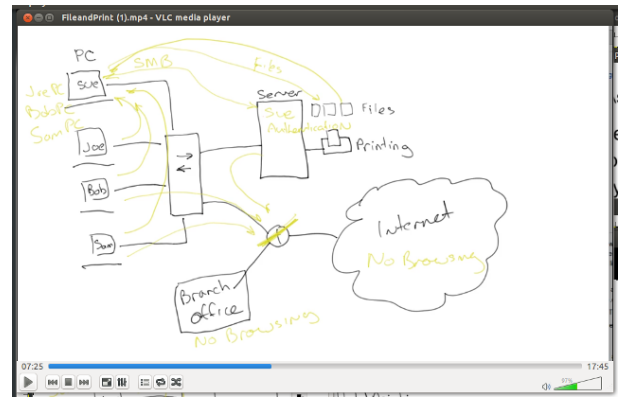Figure 1: Computer aided demonstration with audio narration

Figure 2: Traditional blackboard style chalk and talk

content, voice-over demonstrations are an excellent starting point and introduction to combining video with audio and exploring the basic functions of their chosen video editing environment.

A number of video styles were employed to deliver recorded versions of traditional PowerPoint presentations. One example of this video type is shown in Figure 3. In some instances the presenter's face featured heavily in the recording while in other cases a small face in a window merely reminded viewers who the presenter was. To record the presenters face, internal and external webcams and a digital SLR camera were employed, with each step-up improving the quality of the image. Adding video to the presentations adds considerable complexity. Issues encountered included difficulty in placing cameras in positions that lead to natural looking environments and problems with misaligned audio and video (lip-sync). Editing video without producing jarring and disconcerting jumps in the images is something that requires planning and the unit coordinators found that "delivery" quickly becomes "production". Depending on skill and level of perfectionism, "production" can quickly consume time and creative energy that could otherwise have been devoted to improving the instructional content.

3.2.3 Delivery of videos

The final edited videos were were standardised as high definition 720p in an MP4 container and were uploaded to the university LMS site for students to download. The maximum size of each file was less than 100 MB. Despite testing the files in Windows, Apple and Android environments there were still reports of students experiencing difficulties and the accessibility being less than might be expected from commercial sites such as YouTube.

For some students there were clearly local client issues and quality Internet connections are not universal in Australia. The instructors did find these aspects distracting and time consuming to deal with, particularly as students involved become frustrated with the technology. As the size of the class increases the number of these issues will also grow. There is certainly an incentive to have video content served and managed by a third party that has the expertise and experience to ensure multi-platform compatibility, if those services are not already present in the host's organisation.
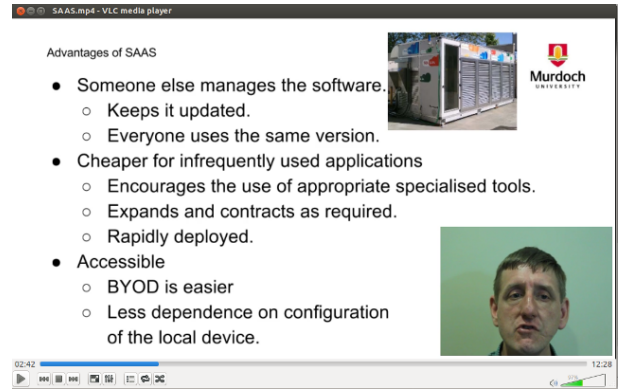

Figure 3: Talking head and slide show

4 Methods

Student perceptions of flipped learning were measured using an online survey. Internal students were delivered a consent form and an online survey at the beginning of the final tutorial (contact the authors for a copy of the survey questions). The research investigators, who were involved in the unit, did not enter the class while surveys were being completed by consenting students and were not provided access to any survey data until after final grades had been submitted.

Students who do not attend classes on campus and are enrolled in external mode, were emailed information about the evaluation and invited to complete the online survey at a time convenient to them. The survey was approved by the Murdoch University Human Research Ethics Committee (Approval No 2014050). The response rate was 73.6% (56 of the 76 who completed more than 50% of the assessment activities).

5 Results

5.1 Access and flexibility

One of the benefits of flipped learning videos is that the content is accessible via all devices and can be viewed and re-viewed at the time and place most convenient to the student. Students were asked what time of the day they viewed the videos. The question was a 'pick all that apply' question and thus the percentages do not reconcile. The results suggest that 90.4% of students viewed them outside office hours. Comparatively, 61.5% viewed the content during work hours. Students were also surveyed about where they watched videos. The majority, 96.1%, stated that

they watched the videos at home. Videos were also frequently watched at university, 47.1%, while usage in other locations, such as public transport was quite small, 7.8%.

Written responses suggest that students appreciated the flexibility of the flipped learning approach.

> *i preferred it due to the flexibility of the unit only needing to be at the the university for two contact hours allowed for more time at home to complete homework,assignments etc, and gave spare time at the university itself.*

> *I liked flipped learning. The flexibility and the total amount of time saved from watching the video lectures ultimately improved my overall performance in this unit.*

> *I found the flexibility helped me fit ICT171 around my lifestyle.*

There were, however, a small number of students that felt the lack of an allocated or scheduled lecture time, hindered their motivation and engagement in the unit. The following are comments from these students:

> *The fact that I don't make time for them or think they are as important as normal lectures.*

> *Motivation to keep on top of the video lectures and readings, it can be quite easily to fall behind*

Students predominantly watched the videos on their PC, 73.1%, or laptop, 75.0%. Smaller numbers of students used their tablet, 21.2%, or smartphone 11.5%. Some students appreciated the ability to integrate the flexible content into they daily schedule. The following are responses to the question, *"What was the worst part of flipped learning?"*:

> *The fact that I could watch it on the train on the way to my class and have everything fresh in my mind, as opposed to watching it right before my class, being up a bit earlier to get to my class. It made it more efficient because instead of waking up that hour earlier I could wake up and head to my class and watch it on the train on the way to the lecture allowing everything to be fresh in my mind.*

Some of the videos were computer aided demonstrations, and some videos may not have played on all devices. This may have caused the usage of tablets and smartphones to be less than originally anticipated as indicated by the following comments:

> *video file formats had problems running in browser or on some smartphones. limited me to watching them only at home or uni.*

> *I had some issues with the videos not playing on my iMac.*

A minority of students also seemed to suffer from technical problems:

> *During the last few weeks I haven't had Internet at home so I haven't been able to watch some of them, but I could have put more effort into downloading them while I was at university.*

> *The state of the Internet in Australia does create some difficulties for some people in accessing these videos. This is a much greater problem than where the student has a physical lecture that they can choose to attend.*

Although a range of different student experiences, preferences and issues are evident, when students were asked to indicate their level of agreement with the statement *"I found the flexibility of flipped learning beneficial"*, there was strong agreement with an average score of 4.21/5. This suggests that on average, the flexibility of flipped videos is favourable to most students.

5.2 Face-to-Face Interaction

One of the fears with replacing face-to-face lectures with pre-recorded videos is a possible reduction in the interaction with staff and peers. In the ISEA flipped classroom, students had only 2 hours of face-to-face contact time per week. For reference, other similar first year units run with a 2 hour lecture and 2 hour tutorial. In response to the statement: *"Compared with traditional units, I interacted more with my peers in the flipped classroom"*, there was general agreement with an average score of 3.59/5. In response to the statement, *"Compared with traditional units, I interacted more with my instructors in the flipped classroom"* there was a similar level of agreement, 3.65/5. This suggests that, despite a reduction in overall class time, the interaction with peers and instructors was higher. This may have occured because of better quality interaction in the tutorial as the following comment indicates: *"The interactive tutorials were more engaging, interesting and I felt I learnt more from them than usual tutorials"*. It must however, also be acknowledged that the unit coordinators took responsibility for a lot of the teaching in this unit. It is possible that their enthusiasm for the flipped learning approach approach had an impact on these results.

5.3 Student Perceptions of Video Types

Students were surveyed about their preferences of video types. The talking head with PowerPoint slides (Figure 3) has the closest resemblance to a traditional lecture and was also the least desirable, with a score of 4.84/7. The chalk and talk, Figure 2, received a slightly higher score of 5.14/7. The most applied element of the course was the computer aided demonstrations, Figure 1, which received the highest student score of 6.08/7. On the same survey page, students were asked about how much they enjoyed traditional lectures with the physical presence of the lecturer. The response to this question was the most neutral with an average rating of 4.06/7. A summary table showing student preferences for different video types is shown in Table 1. In this unit, students least liked the approach that most closely resembled the traditional lecture and students were most satisfied with the applied instruction. Overall, student indicated that they preferred video lectures to traditional face to face lectures.

Written student feedback also suggested that students appreciated the ability to follow along with computer aided demonstrations. These computer aided demonstrations were the elements that would be most difficult to replicate in a traditional live lecture:

Table 1: Student preferences for video types

Question	1	2	3	4	5	6	7	Mean
On a scale of 1 (Did not enjoy at all) to 7 (Very much enjoyed), How much did you enjoy the blackboard style?	1	1	4	4	19	16	5	5.14
On a scale of 1 (Did not enjoy at all) to 7 (Very much enjoyed), How much did you enjoy the computer aided demonstrations?	0	0	2	1	7	21	19	6.08
On a scale of 1 (Did not enjoy at all) to 7 (Very much enjoyed), How much did you enjoy the talking head and PowerPoint style?	0	2	3	8	13	16	3	4.84
On a scale of 1 (Did not enjoy at all) to 7 (Very much enjoyed), How much do you enjoy traditional lectures, with the physical presence of the lecturer?	1	4	10	20	8	5	2	4.06

The ease at which the content was accessible and the ability to work along with the video. I found that it helped me discover and feel more engaged with my learning as opposed to sitting back and listening to a lecture.

i enjoyed the flipped learning system because it gave me the chance to watch the video lectures when i felt it was most appropriate time. It also gave me the chance to work along side on my pc as the video was playing

I find long lectures very boring and find it hard to concentrate. I do enjoy the video formats particularly as with this course they were broken down into specific topics. Which meant I could follow along and recreate on my own computer the various server things that we're being done.

Yes, I generally did as you can wind it back if you missed something.

Although many students, 34.7%, liked to see the face of the person speaking, the majority felt that it was not important. Given the ambivalence of the audience and the work involved, this is an aspect to give careful consideration when developing flipped learning videos. One possibility is the use of short video "bumpers". Bumpers are short video introductions and conclusions that are placed at either end of the video to present a human feel to the presentation with the remaining content consisting of a voice accompaniment to static PowerPoint slides or other visual elements. This approach might achieve a workable balance between some viewers' need to see the presenter's face and the developer's need to limit time spent on the editing process.

5.4 Coverage of material

Pre-recorded semi scripted video lectures are generally shorter than the typical lecture. The average length of video materials was 10 minutes. The total content in each of the teaching weeks averaged 42 minutes 28 seconds, substantially less than the 100 minutes that might be expected in a typical 2 hour lecture time slot. When asked *"Do you feel that less content was delivered under flipped learning?"* the overwhelming response was that the level of content was not compromised. The following student comments were typical:

No - I think there was the same amount of VALUABLE content delivered. This is my last unit, I wish this was in place for my whole degree.

I think it was much more direct, and kept my interest. However, I do think we miss out on the interesting tangents that occur in the lecture theatre.

Possibly less in terms of minutes, but more effective than a 2 hour lecture where you are losing concentration by covering too many topics at once.

No, too much time in lectures is spent arriving, quieting down the lecture theatre etc. I feel the weekly videos provide a more focused environment. I also felt the weekly videos were more rich in content and of a higher quality than the average lecture.

I don't think that less information was covered and that it was just covered in a more concise way with more direct information and less filling that can sometime happen in a defined 2 hr lecture time.

The downside to focused and edited content is that the presentations can become mechanical and less personal. Some students stated that they missed the tangents that lecturers sometimes go off on in face-to-face lectures.

5.5 General student perceptions

General student perceptions of flipped learning were positive. The mean and standard deviation of questions asked about general student perceptions are shown in Table 2. This was also evident in the written feedback from students:

I liked flipped learning in ICT171 because its a better learning experience than a traditional lecture/tutorial. Sometimes traditional lectures go on for so long and some information is lost. With flipped learning tutorial videos shows and give us a good understanding of what it is to do in the labs. Once in class we know exactly what we are doing and any questions can be answered by the tutors. For me Flipped learning is far better experiences learning and more units should implement this method of learning.

I enjoyed the short videos as I found it is much easier to concentrate and take in small videos than a 2 hr lecture. I found the videos to be very useful and related well to the information that was presented in the labs.

Students were surveyed on where they felt like they learnt the most. The majority, 61.5%, felt that they learnt the most in tutorials and 30.8% felt that they learnt the most in lectures. Only a minority of students, 3.8%, felt that they learnt the most in readings and assessment respectively. The transition from a traditional lecture-tutorial format to flipped learning forced considerable efforts and emphasis into the new

Table 2: Summary statistics on general student perceptions

Question	SD	D	N	A	SA	Mean
More university units should use flipped learning	0	3	8	34	7	3.87
Short flipped learning videos are more effective than traditional face-to-face lectures	1	3	8	26	13	3.92
My experience in ICT171 would have been better with at traditional lecture tute format	7	20	20	4	1	2.46

element, the flipped videos. While it is important that these video are well produced and accessible, the results of the survey reinforce the notion that the lectures are present to reinforce the tutorials. Reducing the emphasis on passive, one-way instruction methods is well supported by the literature (Hamdan 2013).

5.6 Future Work

The results described in this paper are preliminary and are purely based on the feedback of an electronic survey delivered to students. Consent was obtained from participants and permission was granted by the Murdoch Human Research Ethics Committee to utilise learning management statistics and data from student records. Future work will provide a more detailed and comprehensive analysis based on this data.

6 Conclusion

Students expressed a strong preference for the flipped learning model. Students liked the convenience and accessibility of the video lectures and in the IT university cohort, student preferences were to view the content outside of standard work hours. Although no group assessment was performed and contact hours were halved under flipped learning, students felt like they interacted more with their peers and instructors.

Students liked the concise nature of the video lectures and generally felt that an equivalent amount of content was covered in significantly less time. Three different video types were used and students expressed a preference for the computer led video where the applied elements of the unit were being demonstrated and discussed. The responses indicate that students often paused, rewound and followed along at home on their own PC. The unit coordinators found these video types the most straight forward from a production perspective. The students least liked the PowerPoint and talking head video type. It is possible that the reason for this was because the talking head video type was used to deliver the majority of the theory in the unit. Videos containing the instructor were the most difficult to produce due to the complexity of editing and many students reported that seeing the instructor's face was unimportant. The instructors found that, despite the emphasis on videos when converting to flipped learning, it is important to recognise that their role is to facilitate the tutorials, where the bulk of learning was reported to occur. Overall, the unit and the flipped learning approach was received very favourably by students.

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