

## Reflections on a flipped classroom in first year higher education

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This paper explores the efficacy of a flipped classroom model for teaching first year students three-dimensional (3D) animation, and analyses the advantages and disadvantages when compared to traditional teaching mechanisms. In 2015, within the course *Introduction to CGI* at the University of South Australia, two different tutorial models were utilised: standard in-class tutorials, within which students were led through a task by a tutor; and 'flipped classroom' tutorials, where students completed a task prior to the session, and then engaged with their peers and tutor in large and small group discussions in the classroom. 128 first year students participated in the course, including 22 international students. The two tutorial models were evaluated at the end of the semester in the form of an online survey, which provided participating students with the opportunity to critically reflect on the learning experience; course staff also appraised the two tutorial formats, providing insight into both learning and teaching experiences. The findings of the study are discussed in light of the growing use of student-centred teaching measures in higher education, and outline the affordances and limitations of each model.

### Student centred learning

It has long been acknowledged that strong engagement with course material and interaction with peers are two crucial elements in ensuring a successful learning experience for students in higher education (Hannafin & Land, 1997; Parker, Maor & Herrington, 2013; Xia, Fielder & Siragusa, 2013). In striving to achieve such engagement and interaction, tertiary educators around the world have established and implemented an array of new learning and teaching formats, with emphasis being placed on student-centred learning (Aguti, Walters & Wills, 2014; Barman, 2013; Jonassen & Land, 2012). While the face-to-face model of a lecture and a tutorial each week has been a standard approach to course delivery in higher education for decades (Butt, 2014), educators have now started to focus on innovative learning styles - such as collaborative learning, problem-based learning and active learning. This change in attitude towards learning and teaching comes alongside advances and exploration into new technologies, such as learning management systems, social networking sites, video lectures and tutorials, wikis, blogs and MOOCS (massive online open courses). Such a focus has been particularly evident at a first year level, with educators identifying the need to immediately engage students and help make the transition to learning at university as easy as possible.

Student-centred learning focuses on methods of teaching that shift the emphasis of instruction from the teacher to the student, and which aim to promote lifelong learning, and both independent and group problem solving (Hannafin & Hannafin, 2010; Jones, 2007; Pedersen & Liu, 2003; Young & Paterson, 2007). In a student-centred classroom the teacher transitions from an instructor to a facilitator and students play a major role in the

education process, where peer interaction and self-directed learning become crucial. Student-centred learning is based on the concept that peer-to-peer interaction and collaborative thinking can lead to a broader and richer knowledge base, as opposed to teacher-centred learning, which can be narrow in scope by comparison (Armstrong, 2012; Butt, 2014; Kraft, 1994). Student-centred learning is a form of active learning which places much of the responsibility of learning on the learners – students must engage with the topic and solve problems, rather than simply listen to the teacher (Prince, 2004). As such, students become keenly involved in two fundamental aspects of the learning process – doing things and thinking about the things they are doing (Bonwell & Eison, 1991). Many educators have found student-centred learning experiences to be effective in higher education, due to the increased level of peer interaction, engagement with course material and a willingness on the students' part to take on more responsibility in their learning (Baxter & Gray, 2001; Butt, 2014; Knight & Woods, 2005; Tarnvik, 2007; Weimer, 2002; Wright, 2011).

### **Blended learning**

The continuing growth of the Internet has led to the creation and integration of new learning spaces and tools in higher education. Incorporating online learning spaces and digital learning tools into curriculum is now commonplace. From formal, structured learning management systems (LMSs), such as *Moodle* or *Blackboard*, through to informal social networking sites (SNSs), such as *Facebook* and *Twitter*, and video and image hosting sites, such as *YouTube*, *Vimeo*, *Flickr* and *Instagram*, universities around the world are integrating online learning into their courses, utilising a 'blended learning' approach. Blended learning is a system within which students engage with course material and interact with staff and their peers through both online and face-to-face environments (Ginns & Ellis, 2007; Graham, 2006). Blended learning has also been referred to as an evolutionary transformation (Garrison & Vaughan, 2008) as a result of the increased accessibility of online systems in universities, and because it can offer stronger interaction within student cohorts, particularly in large classes, through more flexible learning environments (El-Mowafy, Kuhn & Snow, 2013; Gedik, Kiraz & Ozden, 2013). Blended learning has become an indispensable part of education across many fields (Pektas & Gurel, 2014), however creating an effective blended learning environment requires more consideration than simply combining online and face-to-face spaces within a course. It is crucial to consider what the learning objectives of the course are, and to carefully select the most appropriate online space to complement both the traditional teaching techniques being utilised, as well as considering the student cohort in question. The 'flipped classroom' has recently become a popular form of blended learning in tertiary education, as educators continue to strive to engage students in a technology-driven learning climate.

### **The flipped classroom**

A flipped classroom is a teaching strategy, and form of blended learning, which reverses the traditional educational format (Milman, 2012). Within this model, instructional content is provided to students prior to the class, often online and in video format, and learning activities, which are traditionally completed as homework, are moved into the

classroom, under the guiding principle that work typically done as homework is better undertaken in class under the supervision of the tutor (Abeysekera & Dawson, 2015; Crouch & Mazur, 2001; Herreid & Schiller, 2013; Mazur, 1997; Missildine, Fountain, Summers & Gosselin, 2013). While video content often plays a significant role in the delivery of a flipped classroom, it is not just about using videos in classes, but rather how best to use in-class time with students (Sams & Bergmann, 2013). This notion directs a shift in focus of classroom instruction in the flipped model. In a traditional classroom, it is the teacher who is the focus of the lesson and the provider of information. The flipped classroom transfers instruction to a learner-centred model in which students explore topics in greater depth and engage in meaningful learning opportunities with staff and peers (Ronchetti, 2010). A teacher's interaction with students in a flipped classroom can often be more personalised, and students are actively involved in knowledge acquisition and construction as they participate in and evaluate their learning (Abeysekera & Dawson, 2015; Alvarez, 2011).

The flipped classroom approach to teaching has become attractive to educators due to many reasons, including the ever increasing accessibility of online resources, particularly video based resources; the capacity to generate original video-based learning resources; the ability to provide a more personalised learning experience for the students; and the conviction these factors can allow students to produce stronger academic work (Abeysekera & Dawson, 2015; Bishop & Verleger, 2013; Herreid & Schiller, 2013; Mortenson & Nicholson, 2015). Researchers have also identified many possible pitfalls associated with the flipped classroom model. Within any student cohort there is potential for a digital divide to exist. Some students may not have access to the Internet or a computer at home and could therefore be at a significant disadvantage if they are required to view digital content prior to a class (Nielsen, 2011). Students may struggle to adapt to self-directed learning techniques and fall behind their peers (Lents & Cifuentes, 2009; Nielsen, 2011; Strayer, 2012), and they may also be unwilling or unable to immediately adapt to new teaching and learning formats (Baeten, Dochy & Struven, 2012). There are also difficulties associated with teachers. Flipped classroom sessions could significantly increase staff workloads, due to the need to prepare additional resources, while a lack of experience in producing video-based content could lead to poor quality learning resources (Sparks, 2011). It is important for educators to consider these factors prior to utilising such a teaching mechanism within their courses. Based on the existing literature, a list of key potential benefits and pitfalls of the flipped classroom model are outlined in Table 1.

### **Utilising a flipped classroom: A case study**

At the University of South Australia, students have the opportunity to major in animation as part of the Bachelor of Media Arts program, and are introduced to three-dimensional (3D) animation within the first year course *Introduction to CGI*. In previous years, the student cohort in this course has been relatively small, between 30 and 40 students, with animation being a boutique offering. In 2015 however, several changes in program structures and offerings saw the student cohort swell to 128, with students enrolling in the

Table 1: Potential benefits and pitfalls of the flipped classroom model

| Potential benefits  | Potential pitfalls  |
|---|---|
| Students are able to learn at their own pace rather than move too far ahead or fall behind.                                     | Students may have limited access to online resources at home in terms of required hardware, software and Internet.        |
| Students are introduced to self-directed, independent learning techniques, as well as collaborative, group-oriented learning.   | Students may lack the discipline to complete the required work and subsequently come to class unprepared.                 |
| Teachers can gain insight into student performance, as well as learning difficulties and varying learning styles.               | There may be an increase to staff workload, as class resources take more time to prepare.                                 |
| Teachers can customise and update course content more easily and can provide learning materials to students on a 24/7 basis.    | There may be costs associated with preparing course materials, such as video recording and editing hardware and software. |
| Classroom time can be used more effectively and creatively with a focus on peer interaction and engagement.                     | The quality of teacher-created videos may be lacking, if the teacher is unfamiliar with video editing and exporting.      |
| The use of new technologies aligns with the concept of '21st century learning', and may appeal to contemporary student cohorts. | Some students may resist new or novel teaching methods.   |

course from eleven different programs, including Media Arts, Arts, Education, Writing and Creative Communication, Information Technology, Multimedia, Communication and Media, Media and Culture, Journalism, Psychology and Communication and Media Management. This newfound diversity within the student cohort was amplified by the inclusion of 22 international students from China, Hong Kong, Tanzania, Afghanistan, Vietnam, Nepal and India. Producing a 3D animation is a challenging and technically complex process that involves several stages, including modelling, texturing, lighting, animating and rendering, and requires significant skill on the part of the creator. As such, teaching any student how to create 3D animations can be a formidable proposition. Successfully engaging a first year student cohort, featuring such a broad range of educational and cultural backgrounds as found in this course, required a complete review of the course structure and content delivery, and ultimately proved to be the catalyst to explore the efficacy of a flipped classroom model.

Using the 2015 offering of *Introduction to CGI* as a case study, this paper analyses the advantages and disadvantages of a flipped classroom model when compared to traditional techniques in teaching 3D animation. Within the course both traditional tutorials and flipped classroom tutorials were utilised in the learning experience, with the aim of establishing the affordances and limitations of each technique, and to determine which model provides students with a better learning experience, and staff with a better teaching experience. Within this aim were several research questions:

- Which of the tutorial models do students find more engaging?
- Which of the tutorial models promote greater peer to peer interaction?
- Which of the tutorial models promote greater peer to staff interaction?
- Within which of the tutorial models do students achieve greater knowledge transfer?
- What are the workload implications on course staff, for utilising each tutorial model?

## Method

During the course, the two different tutorial methods, referred to in this paper as ‘standard’ tutorials and ‘flipped classroom’ tutorials, alternated each week, enabling all students to experience both formats. In the standard tutorials, two hours in length, students were led through specific learning exercises using the 3D animation software package *Maya*, by the tutor. The tutor covered each task step-by-step, with the process narrated, and presented on a projector. Individually, students completed the task during the tutorial time, asking questions and receiving assistance from the tutor when necessary. The students were then expected to take these newly learned skills, and apply them in their own assignment work in their own time. For the standard tutorials, students were also provided with a set of written notes and screen capture images, detailing the task at hand, as a reference for future work. In the flipped classroom sessions, also two hours in length, students were provided with a video tutorial one to two weeks prior to class, which they were expected to complete in their own time and then bring the finished exercise to the classroom. The flipped classroom session was then broken down into three sections. For the first 10-15 minutes, the tutor played parts of the video on the projector and discussed the key elements within the exercise. For the next 15-20 minutes, the tutor led a group conversation, allowing students to ask questions, solve problems, and discuss related topics with their peers and tutor. For the remainder of the session students were able to work individually and in small groups on their project work. During this time the tutor conducted student consultations, enabling the provision of regular staff feedback in the course.

Prior to running the course, three video recording software packages – *CamStudio*, *Snagit*, and *Camtasia Studio* – were trialled and assessed to determine which would be best suited to generating the video tutorials. Several factors were taken into account to determine which program would be used in the study, specifically the availability and subsequent quality of audio recording; the ability to record the entire desktop; as well as available output formats. *Camtasia Studio* was chosen as the most suitable package, as it featured superior recording capabilities to the other two programs. Despite being significantly more expensive at \$179, compared to *CamStudio*, free, and *Snagit*, \$29.95, the ability to export as an .mp4 file, was seen as crucial to the research project. This ensured that video tutorial files could be produced at a high resolution, making it possible for students to easily identify specific menus and tools in the 3D animation software interface, and could run for between 30 and 45 minutes, while being under 200 megabytes in file size. This was important in the context of the research, as the video tutorials were required to be downloaded from the course’s learning management system by students, either on campus or at home. *Camtasia Studio* also allowed for both high definition and standard definition

video exports, making it potentially easier for students to access the tutorials at home. The three trialled video recording software packages, along with key features and costs are shown in Table 2.

Table 2: Trialled video recording software programs

| Software package       | Key features   | Cost     |
|------------------------|--|----------|
| <i>CamStudio</i>       | Audio recording; entire desktop; basic editing; avi and swf output   | free     |
| <i>Snagit</i>          | Audio recording; entire desktop; basic editing; mp4 output   | \$29.95  |
| <i>Camtasia Studio</i> | Audio recording; entire desktop; high-quality video output; advanced editing capabilities; avi and mp4 output; intuitive interface | \$179.00 |

During the semester six standard tutorials and six flipped classroom tutorials were incorporated into the course, alternating each week. Producing the content for the flipped classroom sessions involved planning, writing, practising and then recording and narrating the exercise on a desktop computer. Once the exercise had been recorded, it was then edited or re-recorded where necessary. Lastly, the video was exported in both standard and high definition versions to accommodate students with varying download capabilities. The video tutorials ranged in length from 30 to 45 minutes, and the process of producing each video, from start to finish, took on average eight hours. It was decided that these videos would be provided in a downloadable format, rather than streamed via *YouTube* or *Vimeo*, to enable students to store the tutorials and maintain access to them without the need for an Internet connection. The video tutorials were provided to students via the course's online learning system at least one week prior to the flipped classroom session. Students were required to complete the exercise and bring their work to class, along with any questions or problems they had regarding the task.

The student experience in the course was evaluated through an online, post semester survey hosted by *Survey Monkey*. The survey included demographic topics, such as gender, age and student type, and allowed students to consider and compare the two tutorial models utilised during the semester. This included evaluating the perceived advantages and disadvantages of each tutorial technique; establishing which format was most beneficial for their learning, considering issues such as accessibility, comprehension, engagement, and knowledge transfer; and indicating which type of tutorial they'd like to see in future courses. Ninety-two students from the cohort participated in the survey, resulting in a response rate of 72%. Participants were given the opportunity to assess the tutorial models in the form of Likert-scale statements and open-ended questions, enabling the provision of both quantitative and qualitative data.

## The student experience

Within the group of respondents, there were higher response rates from females (79% compared with 68% of male students), and locals (73% compared with 68% of international students). Student demographic breakdowns from the participating cohort are shown in Table 3.

Table 3: Student demographics within the participating cohort  
The survey yielded a response rate of 72%

| Demographic           | Number of students in the course | Percentage of cohort | Number of respondents | Percentage of respondents within each demographic |
|-----------------------|----------------------------------|----------------------|-----------------------|---|
| Number of respondents | 128                              | 100%                 | 92                    | 72%   |
| Gender                |                                  |                      |                       |   |
| Male                  | 80                               | 56%                  | 54                    | 68%   |
| Female                | 48                               | 44%                  | 38                    | 79%   |
| Student type          |                                  |                      |                       |   |
| Local student         | 106                              | 84%                  | 77                    | 73%   |
| International student | 22                               | 16%                  | 15                    | 68%   |
| Age                   |                                  |                      |                       |   |
| 17-18                 | 21                               | 13%                  | 20                    | 95%   |
| 19-24                 | 98                               | 70%                  | 64                    | 65%   |
| 25-34                 | 5                                | 13%                  | 4                     | 80%   |
| 35+                   | 4                                | 4%                   | 4                     | 100%  |

In the survey, students were asked which type of tutorial technique they believed was most beneficial to their studies during the semester. 69% indicated they felt the flipped classroom was most beneficial, while 31% preferred the standard tutorials. The flipped classroom model was the most popular format amongst male students (69%) and female students (68%), as well as local students (64%) and international students (93%). Notably, the standard tutorials were more popular amongst students aged between 17 and 18 (55%), while the flipped classroom tutorials were more popular within all other age brackets – 72% of students aged between 19 and 24, and 100% of students aged 25 and over. Table 4 outlines all student responses to the question ‘During the semester, which tutorial technique was most beneficial for your learning’ broken down by gender, student type and student age.

Students who nominated the flipped classroom model as the most beneficial did so for a variety of reasons. The two most prevalent explanations were a) the allowance of studio time and group discussions during the tutorial session; and b) the ability to work at their own pace:

Table 4: Student responses regarding which tutorial technique was viewed as most beneficial, broken down by gender, student type and student age

| Tutorial technique | Male participants |      | Female participants |      | Total participants |      |
|--------------------|-------------------|------|---------------------|------|--------------------|------|
|                    | No.               | %    | No.                 | %    | No.                | %    |
| Standard           | 17                | 31%  | 12                  | 32%  | 29                 | 31%  |
| Video              | 37                | 69%  | 26                  | 68%  | 63                 | 69%  |
| Total              | 54                | 100% | 38                  | 100% | 92                 | 100% |

| Tutorial technique | Local participants |      | International participants |      | Total participants |      |
|--------------------|--------------------|------|----------------------------|------|--------------------|------|
|                    | No.                | %    | No.                        | %    | No.                | %    |
| Standard           | 28                 | 36%  | 1                          | 7%   | 29                 | 31%  |
| Video              | 49                 | 64%  | 14                         | 93%  | 63                 | 69%  |
| Total              | 77                 | 100% | 15                         | 100% | 92                 | 100% |

| Tutorial technique | 17-18 |      | 19-24 |      | 25-34 |      | 35+ |      | Total |      |
|--------------------|-------|------|-------|------|-------|------|-----|------|-------|------|
|                    | No.   | %    | No.   | %    | No.   | %    | No. | %    | No.   | %    |
| Standard           | 11    | 55%  | 18    | 28%  | 0     | 0%   | 0   | 0%   | 29    | 31%  |
| Video              | 9     | 45%  | 46    | 72%  | 4     | 100% | 4   | 100% | 63    | 69%  |
| Total              | 20    | 100% | 64    | 100% | 4     | 100% | 4   | 100% | 92    | 100% |

The flipped sessions worked out well for me. As I was progressing into the more advanced topics, such as rigging, a lot before when we were supposed to, it gave me a chance to finish the prac and then also work on my extra work in class and ask questions about that. Not just the teacher talking over something I had already done and understood. (Local student, male, 19-24)

The video format was more beneficial for me as I could go at a pace suitable for me. This paired with studio time where we were able to ask questions about anything we couldn't understand was really useful. (Local student, female, 19-24)

You had the time to do your assignments in the presence of the tutor. (International student, male, 19-24)

I was really happy with the flipped classroom tutorials because it enabled me to refer to the videos when doing assignments. If I couldn't remember how to do something on Maya, I could go back and look at the video rather than emailing back and forth to the tutor. I was also able to learn at my own speed. (Local student, female, 17-18)

You get to work at your own pace, on your own time, and you've got a very easy to follow tutorial. Then during tutorial time you have more time to ask specific questions. Also having a video tutorial that you can go back to at any time when you forget how to do something is really helpful come assignment time. (Local student, male, 19-24)

The ability to pause, rewind and replay the video as often as necessary to complete the task was also popular, particularly with students who had little experience in 3D animation software packages prior to the course:



It's good because you can pause it and go back if you missed something. (Local student, female, 19-24)

The technology used was brand new to me and I desperately needed and appreciated the option to continually go over basic introductory steps that were fundamental to the process. (Local student, male, 19-24)

The tutor's teaching method and explanations in the videos were great, especially for a student like me who has never had any experience in animation. I felt like I could easily follow instructions and rewind and play again if I had any trouble! (Local student, female, 19-24)

Lastly, some students indicated that the combination of the video tutorials and the studio time in the flipped classroom model contained more information and allowed them to increase their understanding of the topic at a much greater rate:

More time to complete tutorial, can figure out how to do things on your own therefore remembering it better, more time in class for assignment work and more opportunity to ask for advice on assignments in class. (Local student, female, 17-18)

The flipped classroom tutorials enable us to take in and understand more information and therefore learn more in a shorter period of time. (Local student, female, 17-18)

From the 31% of students who indicated they preferred the standard tutorials, the key perceived advantage was having immediate access to a tutor when faced with a problem:

I was able to finish the tutorials faster because I could get help when I was stuck. (Local student, female, 17-18)

You could ask questions as you went along, making the exercise a bit quicker. (Local student, female, 17-18)

Having someone there when you need help; having the exercise on the big screen. (Local student, male, 19-24)

Survey participants noted many disadvantages with the standard tutorials, including the pace at which they were delivered. Some students found the pacing of the tutorial too fast, while others found the pacing too slow:

Having to move at the same pace as all the other students [was a disadvantage]. (Local student, male, 19-24)

It was often hard to keep up, especially if the computer you were at made your back face the projector screen. (Local student, female, 19-24)

Sometimes the pacing was a bit fast, so doing the exercises felt a bit rushed. (International student, male, 19-24)

It can sometimes feel like it's a bit too slow. I often found myself going ahead in the PDF notes. (Local student, male 19-24)

The standard tutorials often moved fast especially when I missed a step or got stuck. And in a classroom with people who seem to have done animation before, there were only so many questions I could ask before it became embarrassing! (Local student, female, 19-24)

It can be hard when you fall behind or you miss something and then you slow the rest of the class down while the tutor backtracks to catch you up. The advantages are when you do mess up, you've got an expert there to answer the question. However you are sharing that time with everyone else. (Local student, male, 19-24)

Sometimes hard to follow as an international student. (International student, female, 19-24)

Other students noted an inability to return to some concepts and techniques, despite the provision of written notes accompanying the delivery of the standard tutorials:

The disadvantage is the hand, eye and listening coordination, where a lot of unwritten information can be missed and unable to be accessed later. (Local student, female, 35+)

The pdf notes can only contain so much information. It is just not as possible to be as detailed in the written notes as the tutor could be in the video narration. (Local student, male, 35+)

The standard tutes were harder because we couldn't go back later and do the exercise again as we did in class. The notes helped but weren't as complete as the videos. (International student, male, 19-24)

Within the survey, there was a series of Likert-scale questions allowing student to provide more detail in regards to their analysis of the two tutorial techniques. When asked whether the standard tutorials were easy to follow and understand, the mean response, on a scale from 1 (strongly disagree) to 5 (strongly agree) was 3.51, with a broad agreement (responses of 4 or 5) of 69%. By comparison, 89% of participants indicated they found the video tutorials easy to follow and understand, with a mean response of 4.17. It was also important to gauge the accessibility of the video tutorials, both in terms of file size and video quality. The videos needed to be of a high enough quality for students to clearly understand the concepts presented within, but also a small enough file to be easily downloaded. 91% of respondents found the video tutorials easy to access and watch, provided a mean response of 4.33:

The video tutorials were superb. You had a finished product to compare and evaluate your own efforts; it was a fantastic aid for someone brand new to and struggling with the technology. (Local student, female, 25-34)

The video tutorials were a good way to get the lesson across and then also gave the students studio time to ask questions about assignments and work on assignments under the watch of the tutors. (Local student, male, 19-24)

Table 5: Mean response and broad agreement data related to Likert-scale statements in the survey

| Topic  | Male students           |                 | Female students         |                 | All students          |                 |
|--|-------------------------|-----------------|-------------------------|-----------------|-----------------------|-----------------|
|  | Mean response           | Broad agreement | Mean response           | Broad agreement | Mean response         | Broad agreement |
| Were the standard tutorials easy to follow and understand? | 3.63                    | 70%             | 3.34                    | 66%             | 3.51                  | 69%             |
| Were the video tutorials easy to access and watch?         | 4.37                    | 91%             | 4.26                    | 92%             | 4.33                  | 91%             |
| Were the video tutorials easy to follow and understand?    | 4.02                    | 85%             | 4.40                    | 95%             | 4.17                  | 89%             |
| Topic  | Local students          |                 | International students  |                 | All students          |                 |
|  | Mean response           | Broad agreement | Mean response           | Broad agreement | Mean response         | Broad agreement |
| Were the standard tutorials easy to follow and understand? | 3.68                    | 74%             | 2.67                    | 47%             | 3.51                  | 69%             |
| Were the video tutorials easy to access and watch?         | 4.35                    | 90%             | 4.20                    | 93%             | 4.33                  | 91%             |
| Were the video tutorials easy to follow and understand?    | 4.14                    | 88%             | 4.35                    | 93%             | 4.17                  | 89%             |
| Topic  | 17-18 year old students |                 | 19-24 year old students |                 | +25 year old students |                 |
|  | Mean response           | Broad agreement | Mean response           | Broad agreement | Mean response         | Broad agreement |
| Were the standard tutorials easy to follow and understand? | 3.80                    | 70%             | 3.48                    | 67%             | 3.00                  | 63%             |
| Were the video tutorials easy to access and watch?         | 4.45                    | 90%             | 4.35                    | 93%             | 3.75                  | 75%             |
| Were the video tutorials easy to follow and understand?    | 4.25                    | 85%             | 4.15                    | 90%             | 4.25                  | 100%            |

The survey used a 5-point Likert scale from 1 (strongly disagree), to 3 (undecided), to 5 (strongly agree). Table 5 outlines all student responses to the Likert-scale questions, broken down by gender, student type and student age.

Within the survey, students were also encouraged to provide any suggestions they had to improve the quality of both the standard and flipped classroom sessions. Many students acknowledged that it would be difficult to tackle the principal problem associated with the standard tutorial – pacing and delivery of content – as different students will always work at differing speeds. Several students indicated that the cohort could be split into beginner and advanced groups in the tutorial sessions, although this could be challenging to timetable. In regards to improving the flipped classroom sessions, focus was mainly placed on the final edit of the video, with some students indicating chapter markers in the video tutorials would allow for easier navigation, particularly in the videos which spanned more than 30 minutes.

Students were asked to reflect on the impact the different tutorial models had on their academic work in the course, in terms of reusing or returning to information presented within the sessions. 100% of survey respondents indicated they referred back to at least one video tutorial later in the semester to help with their project work, as well as referring back to feedback provided by tutors in the studio sessions. 94% of respondents indicated they referred back to two or more video tutorials during the semester. In terms of the standard tutorials, 84% of respondents indicated they referred back to the provided pdf notes from the standard tutorials at least once during the semester, and 75% of students referred back to written notes they had taken. When asked which tutorial models they would like to experience in similar courses in the future, the vast majority of respondents, 80%, indicated they would like a combination of both standard and flipped classroom tutorials. 13% indicated they wanted only flipped classroom tutorials, and 7% indicated they wanted only standard tutorials. Student comments included:

A combination is good. Then you can work at your own pace, but get help if you need it. (International student, male, 19-24)

A combination seems fitting. The video tutorials made it feel like I had two separate tutors for the same course, which was nice. (Local student, female, 25-34)

I have a preference for flipped but there may be some lessons which would benefit from the in-class experience, particularly the first time a topic is taught. (Local student, male, 19-24)

## The staff experience

The staff experience was also evaluated at the end of the semester, with the two course tutors invited to provide their thoughts on the different tutorial techniques through another online survey hosted by *Survey Monkey*. The survey included questions related to the teaching experience in each format, as well as the perceived learning advantages and

disadvantages for students. Both tutors acknowledged that the flipped classroom format featured many advantages over the standard format:

The flipped classroom format made it easier for students to follow along compared to notes and screenshots as they can view the whole process as it happens. The ability to pause to allow them to catch up, plus the ability to rewind to clarify or watch steps again makes learning complex processes much easier. Producing the videos gave you the ability to be much clearer in content presentation, to provide secondary thoughts and reasoning about why you may be doing things, rather than just steps and notes.

I feel students found the process more engaging and it therefore became more enjoyable to learn complex steps.

I noticed that students seemed more engaged and focused on the content when viewing it on their screens, rather than if they were watching it being delivered on the projector.

The key advantage of the flipped classroom was opening up the tutorial time for studio work. It enabled me to talk to all students individually or in small groups about their work. Some students also seemed more open to raising questions in a one-on-one environment, rather than in front of the whole class.

The process of teaching was much easier using this model [the flipped classroom]. It can be hard in a regular session because some students are way behind others and you end up spending all of your time with them. It feels like a less engaging session when that happens; there's less academic interaction between students.

The studio sessions saw far more interaction between peers – students were showing each other their work, asking questions and providing answers, sharing ideas. In the regular sessions students concentrated on the task at hand and little else.

The tutors also noted some disadvantages of the flipped classroom model, specifically the time it took to prepare, record, sometimes re-record, and export the required content:

The first couple of video tutorials were quite hard to put together. The process was quite in-depth – writing the task and delivering it in class is one thing, but to perform and record the exercise perfectly for video is another. It took a few times to get the first video tutorial recorded to an appropriate quality – the narration was perhaps the hardest part, as you want it to be professional and clear, without being scripted or monotone. After the first one however, the process became much easier.

Another potential disadvantage of the flipped classroom model to arise related to student attendance. A tutor found that attendance dropped in one tutorial group during the flipped classroom sessions, potentially due to students not having completed the required exercise, or believing they didn't need to attend class since they had already completed the exercise:

Attendance was down in one group, my assumption being that because they could access all of the delivery via a video, they felt they didn't need to attend studios, or hadn't done the work and had nothing to show.

Attendance in the other tutorial groups however remained consistent over the semester. Based on the recorded staff and student experiences from this study, key advantages and disadvantages of each tutorial model are outlined in Table 6.

Table 6: A summary of affordances and limitations of each tutorial model

| Tutorial model    | Affordances   | Limitations  |
|-------------------|---|--|
| Standard          | Students can ask questions during the class to solve problems straight away.<br>Unforeseen issues can be raised and solved with the whole class.<br>Lower staff workload, as class resources are easier to prepare.   | The pacing of the session can be too fast for some students and too slow for others.<br>Limited amount of one on one time between staff and students.<br>Lacks the depth of knowledge presented in the video tutorials-Less academic interaction between peers in class.   |
| Flipped classroom | Students can work at their own pace.<br>Students can pause, rewind and replay the video as often as they need.<br>Allows for better utilisation of class time, allowing students to work on assignments in class alongside peers and staff.<br>Can provide students with access to multiple tutors.<br>Promotes more group discussions and group problem solving.<br>Promotes self-directed, independent learning.<br>Can promote stronger interaction between peers.<br>Can promote stronger engagement with course material and assignment work.<br>Enables stronger knowledge transfer for international students. | If students miss a step or can't follow the exercise, they have to wait until class to resolve the issue.<br>Large file size (compared to written notes).<br>Can impact on attendance, if students have not completed the task ahead of schedule.<br>Cost implications for high quality screen recording software.<br>Increased staff workload due to longer preparation time to generate the class resources. |

## Discussion

The post-semester questionnaire provided insight into the student experience, and their attitudes towards the different tutorial models. Despite the flipped classroom model being significantly more popular, the majority of students indicated that they would prefer to have a combination of the two tutorial formats in future courses, rather than just flipped classroom sessions. This demonstrates that the student cohort responded positively towards a variety of learning experiences, and further emphasises the importance of blended learning in contemporary higher education. There was no discernible difference in preference between male and female students, however there was a significantly higher preference for the flipped classroom model amongst the international students within the course. This can be linked to the learning benefits afforded by the video tutorials,

specifically the ability to pause, rewind and replay content, allowing students to continually watch and listen until they understand the discussed concepts. In the standard tutorials, some of the international students indicated that they didn't immediately comprehend what was being taught, and as a result failed to grasp a clear understanding of the task at hand.

There was a clear preference (75%) for the flipped classroom model amongst all students aged 19 and over, however a slight majority (55%) of students aged 17 and 18 preferred the standard format, despite the same students indicating they found the video tutorials easier to follow and understand. This can potentially be attributed to their learning experiences in high school. These students have come into university straight from school, as opposed to coming from other tertiary institutions or industry, and may lack experience in self-directed learning, instead preferring the familiarity of a teacher-centred learning experience. This suggests that the flipped classroom model may help fast-track school leavers' capacity for independent learning by driving them to adapt to new learning experiences. The flipped classroom model afforded a higher level of knowledge transfer amongst all demographics within the student cohort, and proved to be particularly important for both mature age students and international students, with 93% of international students and 100% of students aged 25 or over finding the video tutorials easy to follow and understand, compared to just 47% and 63% respectively for the standard tutorials.

The course tutors provided much insight into the learning experience and despite an increase in workload, there was a clear preference for the flipped classroom model. From a teaching perspective, the key benefits to arise from this format were increased understanding and engagement with course material, and stronger student-to-student and staff-to-student interaction in class. The factor that contributed most to the increase in staff workload was the process of recording and then exporting multiple versions of the video tutorials. It became evident in the study that the video tutorials need to be outputted at a high enough resolution to clearly identify all aspects of the software interface. While two versions of each video were provided – high definition and standard definition – students rarely accessed the standard definition version, as the image quality was simply not good enough to clearly understand what was happening on screen. As it took up to an hour to export each version, only providing the high resolution option would significantly improve staff workload. While the high definition version was visually very clear, there needed to be consideration for balance, in terms of video length and information provided. The video needed to be long enough to clearly cover the content being presented, however concise enough to maintain the students' attention, and to achieve a file size that was easy to download. The vast majority of students indicated that they found it easy to access and watch the provided video tutorials, however it must be remembered that there exists a digital divide amongst students.

Students come from a range of socio-economic backgrounds and viewing digital content at home, particularly online, may not be possible for everyone. An important part of planning for this study was ensuring that all students had the ability to access, download and watch the videos at university. Students were provided with all the required resources

on campus to view the videos and complete the tutorials. They could also download the videos and watch at home even if they didn't have an Internet connection.

The primary aim of this study was to establish the advantages and disadvantages of each technique, and to determine which model provided students with a better learning experience, and staff with a better teaching experience. It is clear that the flipped classroom model provided both students and staff with significant learning and teaching benefits, including engagement with course material, a clearer understanding of technical course content and more meaningful interaction between participants. The majority of students however, indicated they would like to experience a combination of both tutorial formats in future courses highlighting the importance of taking a blended approach to learning and teaching, and utilising multiple learning experiences and spaces, particularly when teaching first year students. Such an approach will promote greater understanding of course material, and can accommodate the diversity of skillsets and learning attitudes found within contemporary tertiary student cohorts.

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