Beyond lecture capture: Creating digital video content for online learning-a case study

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Beyond lecture capture: Creating digital video content for online learning – a case study

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Abstract

Use of multimedia for teaching and learning, particularly digital video, has become ubiquitous in higher education. This is driven in part by the growth in blended pedagogies and an increase in students learning solely or partly online. It is also influenced by relatively inexpensive media production equipment, faster internet speeds, student access to mobile devices and a rise in media production skill sets. Where students are studying solely online, this content becomes essential as it replaces the traditional lecture in the design of the course ("course" refers to individual course, subject or unit of study). Digital video can be an extremely effective way to reach students with course content. One of the main benefits is the flexibility it affords. Students can view the course material when and where they like, on multiple devices. They can rewind, slow down or speed it up – they can revisit particular videos prior to assessments. There have been two primary drivers of the development process of this content. Firstly, a focus on high quality, and secondly, a focus on accessibility. Videos have the potential to be more inclusive as they are accessible to students with a range of disabilities. We have included subtitles with all videos as a minimum requirement. What follows is a case study on the creation and distribution of a large volume (around 6000 items) of digital content designed to support teaching and learning in a newly created suite of completely online undergraduate degrees. This case study will outline the various challenges which are presented by creating and supporting this volume of material and is informed by the results of a survey of students, detailing their usage patterns and habits.

Introduction

Driven by technological advances and evolving pedagogical practices, the past decade has seen the use of internet-based multimedia for teaching and learning, particularly digital video, become extremely prevalent throughout higher education. More specifically, this transformation is influenced by a range of factors, including faster internet speeds, student access to computers and mobile devices, relatively inexpensive and easy access to media production equipment, a rise in media production skill sets, the growth in blended pedagogies (i.e. flipped classrooms) and an increase in students learning solely or partly online. Many educators have recognised in digital video a unique set of affordances that are believed to enhance learning for students beyond the traditional didactic lecture. The increase in the use of video for higher education and the many benefits of doing so staff, students and institutions have been well articulated by (Hansch 2015; Kay 2012; Koumi 2014; Mayer 2017; Woolfitt 2015). These benefits include

- increased flexibility – time, place, speed, hearing ability;
- sense of personalisation and social presence for the learner (Borup et al. 2014);
- video allows for unlimited repetition and revision;
- perceived higher levels of student engagement;
- promotion of active learning pedagogies;
- additional language acquisition; and
- for fully online courses (where "course" refers to individual course, subject or unit of study), digital video represents an essential point of contact between teacher and student as they replace the traditional lecture in the course.

For these reasons, when a large Australian university set out to create a new suite of fully online programs (or degrees), it was decided that digital video would form an integral part of the overall course design. The newly created entity was to provide 12 to 15 fully redesigned degree programs in its first set of offerings. As the programs were to be 100 per cent online, the design, creation and implementation of the content for students was of critical importance. The degrees and the courses within them were to be designed and built from the ground up with the two principle aims being to make the content, including the multimedia elements, as high quality and as accessible as possible. The projected demographic makeup of the student cohort for these programs was quite specific. These were not school leavers, but rather those who had left school some years ago and were now looking for promotion, career change or enhancement. This older group therefore had a different range of needs. They were more likely to have families, already be in in full time work and to have greater general levels of responsibility. Due to these increased time pressures, this is a group of students who want a high level of flexibility and more control over how they learn. The profile of student enrolments during the first year have proven this projection to be correct [87 per cent of commencing students were aged over 22]. Therefore, fully online learning, supported by digital video, fits the needs of this group of students very well. The specific needs of the digital video production project were outlined as follows: the content must (1) be high-quality, high definition video and audio (2) have the ability to be autonomously produced by staff if they chose and (3) be universally designed to have a high level of flexibility and accessibility.

The decision was made to invest in both the infrastructure and staff to realise these ambitions. During the first two years of this project a studio was created that produced and hosted around 6000 high quality, fully subtitled videos. This content received more than 160,000 views and obtained very high student satisfaction ratings with 88.84% of students being either very satisfied (42.06%) or satisfied (46.78%) with the video content in their course, [n = 233] and 94.17% of students either strongly agreeing (45.42%) or agreeing (48.75%) that "the videos increased my understanding of

topics or concepts" [n=240]. This case study will outline the responses to the above mentioned project needs – the processes involved in producing this volume of material and the results of a student survey of usage habits and satisfaction. This survey was optional and was carried out over a two-week period at the conclusion of a full year of study. It was targeted at all students who had enrolled (2,555) regardless of successful completion and received 241 individual responses. The survey was designed to assess student satisfaction with content and usage habits. At this preliminary stage there has been no attempt to correlate data with overall student achievement. Also included is an outline of the key findings from this process and a set of recommendations for approaching a project of this type.

Meeting the project needs – high quality and autonomous video production

In order to deliver on the project needs, as outlined above, the university decided to make a large investment in infrastructure, equipment and people. The key element of the infrastructure development was the building of a large, fully automated green screen studio with a separate voice recording booth and an editing suite. The university had a large amount of experience in creating studios of this type, having previously built four others, but they had been retro-fitted spaces of varying quality. This new studio was a large, dedicated space studio featuring a green screen, multiple monitors and the ability for staff to record their content autonomously and leave the studio with their high-definition recording on a USB drive. The capability for autonomous production was essential as it was projected that there would be large volumes of content produced.

The studio was large enough to accommodate various types of production, but it was known that the vast majority would be pieces spoken to camera. The voice-over booth was created to allow staff to produce high-quality desktop captures, which also proved to be very popular with staff and students. There was also a large investment in camera equipment, for both studio and location shoots and in digital editing equipment. Two full-time positions were created – one a specialist video editor and one a studio and production manager. The productions were also supported by a range of casual employees who fulfilled various duties – graphic design, subtitle transcribing and editing.

As the studio was opened for business, training was offered for all staff coming into the space and the first videos created were designed to support staff to create their content effectively and autonomously. It became clear that staff training for production of this type of content would be different to the usual profile of staff training. In effect, staff needed to be trained to communicate effectively to the camera, as this is quite different to the approach taken when preparing for a lecture or a tutorial. A series of training workshops was created to support staff with effective communication skills, hosted by a staff member with experience in the television industry. The training involved reading from autocues and limiting eye movement, standing still while delivering, making decisions about the appropriate clothing (no green) and whether or not to wear make-up. Staff also needed to be introduced and to participate in a preproduction process which emphasised the great deal of work required before even stepping in to the studio. As noted by Hansch et al. 2015 'it is often very challenging to get instructors to understand the importance of pre-production preparation,' and this proved to be the case. The studio was designed to be autonomous, but in reality it should best be described as semi-autonomous. Those making recordings simply needed to plug in a high-capacity USB drive in to one of the ports in the studio and after recording leave with their video files, but the complexities of using the space often meant that the studio staff were needed to supervise, and in some cases participate in, the recording process. Another factor is that the footage is unedited. In some cases, staff were able to complete this process themselves, but generally a time-

consuming postproduction procedure was required. This included not just the editing but the addition of content to the course channel and the embedding process. In response to these factors a set of production guidelines was created to assist the planning of staff coming in to the studio.

1. Write a script if you can – or at least a set of talking points. This helps to guide your thinking, encourages you to be concise, and can also be repurposed as a transcript to be made available with your video. Writing a script also means the text can be easily added to the autocue.

2. Choose an appropriate background. As you are shooting in front of a green screen you can choose whichever background you like, but make sure it is appropriate and does not detract from your presentation. If you are going to be talking to a PowerPoint presentation, make sure it is designed so as to leave on-screen space for you.

3. Importance of practice. Read your script out loud prior to your recording and make sure your timing and emphasis are as you'd like them. Make sure you articulate every word.

4. Video length. One of the most common questions asked by staff was "what is the ideal length for a video?"

There is a great deal of debate about video length, largely informed by the influential 2014 study by Guo, Kim and Rubin from Massachusetts Institute of Technology (MIT), that analysed 6.9 million videos based in massive open online courses (MOOCs) and concluded that videos should be no longer than six minutes. Their contention is that attention drops off dramatically after this short amount of time. Business video hosting firm WISTIA conducted research in 2016 on 564,710 videos and 1.3 billion views and concluded that 6 to 12 minutes is the video length 'sweet-spot'. In practice, this is a contentious area of advice to give to lecturers producing content for their courses. Some are used to giving lectures that last between 50 and 100 minutes, and do not find it easy to make the adjustment. In providing guidance to staff on this topic we highlighted the difference in communicating in the new medium and the need to be concise, without giving a specific timeframe.

We suggested that staff should design videos to cover a particular concept or topic. Using this model, a traditional lecture becomes a series of shorter, self-contained, but related clips. This is directly in line with Mayer's (2017) "segmenting principle", which states that "people learn better from a multimedia lesson when it is presented in user-paced segments rather than as a continuous unit." This has several advantages. Initially, the lecturer begins to build up a database of videos focusing on a range of topics. In a modular environment like a learning management system (LMS) this content can be accessed by students who would like to access a particular topic or concept. These more focused videos are more easily updated, and once made become an asset to a lecturer for potential future use.

A production application process was designed in response to this initiative. Staff wanting to produce a video were asked to complete an application form which outlined their intentions, intended audience, experience and the level of pre-production already completed. Hence a hybrid system was introduced. It was possible to come in to the studio and autonomously record a video and leave with the unedited clip, or staff could apply for assistance with preproduction right through to editing and implementation. It was also decided that location shoots would be made available, and many staff took this opportunity.

What emerged was a range of video modalities that were fully supported by the studio and the available production staff. This type of material typically takes the form of a lecturer directly delivering content to camera – this is often augmented by a presentation in the background. Another

common mode is a desktop capture in which the computer screen is captured simultaneously with the recorded voice of the presenter. Other options include interviews, case-studies, role-plays, documentaries, or use of third-party content. This variability in types of material can be more effective for student learning because they utilise digital video's affordances and don't necessarily replicate the transmission style of direct-to-camera delivery – which is more like a traditional lecture. For example, some research has suggested that one of the most effective designs for student learning involves the addressing of student misconceptions (Muller et al. 2008) and this can be achieved through a scripted interview, question and answer or case study.

It was unknown how many videos would be produced, but given the number of programs and courses it was estimated that it would be in the thousands, especially as the production of shorter, more concise videos was being strongly encouraged. It was decided after a great deal of discussion to use YouTube to host the content as opposed to our own in-house video hosting service. This was for a range of reasons. The first of these was the user experience offered by YouTube. We could ensure that our students would have the best possible viewing experience on whichever device they would be using to view content. YouTube is also capable of handling very large volumes of content and conforms to the device and bandwidth available to individual users; this was essential for an effective viewer experience. It is also available on a broad range of devices through both browsers and apps. It also allows easy embedding of content in to websites – in this case our LMS – and a high level of user control over content. This high level of user control over content and the flexibility it affords is one of the primary reasons for choosing digital video from the outset. At the early planning stage, it was assumed that a large amount of the viewing of material would be done on mobile devices and tablets but that has since proven to be incorrect with user data from the channel showing that 90.2 per cent of viewing was done on either desktop or laptop computers. There are, however, some disadvantages in using a free, third-party service like YouTube to carry content. The primary one is the chance of channel suspension due to copyright infringement. Given that university content includes sources of material from across many domains this risk is ever-present. This has not proven to be a problem during the first year of operation and editors and producers are vigilant in ensuring correct attributions are provided for all material. Other disadvantages like advertising, negative commentary and the auto-play function (which takes viewers to other similar videos and can be a distraction for students) can all be overcome by disabling those features for users of the channel. It was also decided that all the videos would be set as "unlisted", (as opposed to "public" or "private"). This means that they can only be viewed by those who have been sent a direct link; they are not discoverable through the usual search function.

In addition to the user experience, a key influencing factor in the decision to use YouTube was the service's ability for auto-transcription and creation of subtitles. We had conducted a research project (Dinmore & Gao, 2016) to determine the best process for auto-transcription. In brief, the project determined that the factors influencing the highest level of accuracy for auto-transcription were the use of high-quality audio recordings and the Google algorithm for auto-transcribing. The study also showed that some level of human intervention was essential for 100 per cent accuracy, a level of accuracy which was deemed essential for educational purposes, as students must be able to rely on the spelling and usage of technical and specific terms in their courses. Testing had shown that Google's service was 10 to 20 per cent more accurate than other comparable services and since Google now owned YouTube and had integrated it in to the system, this would be the best way forward. The advantages of this for students will be discussed in more detail below.

Flexible use of video

Flexibility in the way that video is consumed is the key feature that makes it so effective for online learners. In this section these affordances are discussed along with the results of a student survey

and usage data from around 6000 videos. The time of day that a video is viewed is entirely up to the student and this can have obvious benefits for the online learner who, as previously mentioned, is potentially time poor and juggling various responsibilities. This time-shifting also extends to the amount of times that a student views the content and this ability to repeat a video as many times as a student requires is one area that sets it apart from a traditional lecture. Of students surveyed, 93.72% [n=239] indicated that they had revisited videos when preparing for assignments. These findings from the survey correlated strongly with other studies based on student behaviour. In 21 studies outlined by Kay (2012, p. 823) in his study *Exploring the use of video podcasts in education: A comprehensive review of the literature*, it was "reported that students used video podcasts to review for impending tests or examinations." Clearly, repetition, or targeted revision, is a learning strategy used by many online students.

In addition to this, the ability to manipulate digital video, or what Laurillard (2002) calls "self-pacing", is an affordance adopted by the majority of students in this study. Adjusting the speed of the video was widespread among students with 73.31% [n=239] of students indicating that they had sped up or slowed down a video while watching. 99.16% [n=239] of students indicated that they had rewound or paused a video, to some extent, while watching. The reasons for this level of intervention in the content remain unclear, but these results point to a cohort of online learners prepared to use the affordances of digital video as part of their learning strategy.

Analysis of the place of viewing and the devices used to view also proved interesting. Early assumptions for this project were that a busy cohort of students would use mobile devices extensively, but this has not proven to be the case. Data from the YouTube channel used for the project indicates that 90.8% of views were on computer (either desktop or laptop) with 9.2% of views on mobile devices (either mobile phone or tablet). This correlates with the survey data, [91.63% computer, 8.37% on mobile device, n=239]. To add context to this result, students indicated in the survey that the location they viewed "most" of the content was as follows, [Home 87.30%, Work 6.26%, Public transport 4.18%, Other 2.51%, n= 239]. This means that the viewing of material is overwhelmingly done at home on desktop or laptop computers and correlates with a large number of studies (12) in the review by Kay (2012, p. 822), which stated that "that students tended to listen to podcasts at home rather than on mobile devices."

Meeting the project needs – universal design and accessibility

One of the key needs of this digital video production project was that the content be universally designed and as accessible as possible. Another advantage of the flexible nature of video at the point of consumption means it can play a key role in increasing access for students with varying abilities as they can manipulate the size, speed, volume etc. Universal design of course content has gained a great deal of traction in the last decade as part of a broad push towards widening participation, but is also in recognition that this approach is effective for the student population in general. A set of principles to help achieve this goal has been developed by the Centre for Applied Special Technology (CAST) called Universal Design for Learning (UDL). The second principle of (UDL) states that course content must have "multiple means of representation", (CAST, 2018). This means that students must be able to access similar material through multiple means, thus levelling the playing field for all. Adding same-language subtitles (SLS) to video is an effective way of achieving this, with numerous studies demonstrating the benefits (Gernsbacher, 2015). The addition of SLS with this digital video content potentially creates an environment for students which increases comprehension and engagement but also provides equitable access for a range of students with varying abilities and needs. What follows is a brief outline of the benefits of SLS for students and the details of how 100 per cent accurate subtitles were added to a large volume of content as part of the video production project.

Some of the benefits of SLS include:

> **Increased accessibility for deaf or hard of hearing viewers** – Perhaps the most obvious advantage of subtitles is their use by those with hearing difficulties (Burnham et al. 2008; Stinson 2009; Wald 2006). The advantage of subtitles for those with hearing problems is clear, but an added advantage is that it also becomes more accessible for students in sound sensitive situations.

> **Improves comprehension for all students** – SLS can have a powerful impact on comprehension for all students (Brasel & Gips 2014; Kothari 2008; Steinfeld 1998). Providing this kind of access for students is an excellent example of UDL principle 2 (provide multiple means of representation); it can enable the curriculum for all students, not just those with disabilities. "Multiple studies have shown that the same options that allow students with physical and sensory disabilities to access materials, specifically captioning and video description, also provide educational benefits for students with other disabilities, English language learners, and general education students." (Sapp, 2009, p. 496).

> **Translation into foreign languages** – As higher education becomes increasingly globalised with many courses available internationally, the need to provide means of comprehension for students from a variety of language backgrounds is crucial (Kruger, Hefer & Matthew 2014).

> **Enhances foreign language Learning** – Multiple studies (Etamadi 2012; Mohsen 2015; Vanderplank 2013; Zanón 2005), have outlined the effectiveness of SLS for students learning a new language. This is because they influence factors like pronunciation, context, speed, reading skill, understanding colloquialisms and aid with rapid word recognition. Given these advantages and the stated project need to provide content which is as accessible as possible it was decided to provide SLS as a minimum requirement for all digital video.

Logistics of the transcription process

The process of creating 100 per cent accurate transcriptions for a very large volume of content represents a significant challenge. As outlined in the above study, auto-transcription can be highly effective, but there are two additional factors that contribute to the efficiency and accuracy of the process. The first of these is the importance of high-quality audio recording for creating the transcripts and the need for some level of human intervention. This intervention, the correction and publishing of the auto-transcripts, is extremely costly. Therefore, the plan was to create a system whereby the highest possible quality of audio was used, making the cost of the human intervention less. The studio was supplied with lapel microphones and an investment was made in high-quality microphones for external shoots. The voice booth was specially designed for voice recording and came equipped with a professional standard microphone. The result of this combination of the Google algorithm and the use of high-quality audio content was that the auto-transcriptions were generated at an accuracy of between 90 and 95 per cent. The human intervention has proven costly with the equivalent of one full-time position required to correct punctuation and spelling and to manage the process of implementation. However, this cost is seen as an investment in student learning and an essential enhancement for the fully-online learner.

Same language subtitle use by students

Students were asked about their use of subtitles embedded in their course videos. Subtitle use was supported, with the survey indicating that 75.73% of students had "read the subtitles while viewing the course videos" [n= 239]. Students were also asked "did the subtitles increase your understanding of topics and concepts?" [Yes 57.32%, No 21.76%, Unsure 20.92%, n=239]. These results point to the effectiveness of the second principle of UDL (providing multiple means of representation), and that these accommodations are used by, and are important for, a broad range of the student cohort. This use of subtitles, however, runs contrary to Mayer's "redundancy principle" (2017), which states that "people learn better from graphics and narration than from graphics, narration and on-screen text." This means that the addition of subtitles to a video already containing a speaking head and a presentation would detract from the learning environment for students. This assertion is reconsidered by Ozdemir, Izmirli and Sahin-Izmirli (2016) who found that "in contrast to the suggestion of the redundancy principle, motivation and achievement scores of students do not vary according to the instructional video type under investigation (subtitles vs. non-subtitled)" but, in contrast, is supported by Poquet et al. in their (2018) *Video and Learning: A Systematic Review (2007-2017)*. In line with the project commitment of providing students with a high level of flexibility in the way they viewed content and with the need to provide an accessibility option it was decided to make the subtitles appear as the default mode with the videos; however, the option was given to turn them off completely if the student chose – as well as the ability to change the colour, size and font of the subtitles or mute the audio. With this range of options, a student could take control over the way they learned – a student with a hearing impairment or with English as an additional language could leave the subtitles on, but another student could turn them off. Students were asked "did you ever turn off the subtitles?" [No 65.69%, Yes 25.10%, Unsure 9.21%, n=239].

Some qualitative data was also collected on this topic. Students were asked about their reaction to the use of subtitles in all videos [n=88]. This selection of responses points to the effectiveness SLS for learning depending on the context of the individual learner.

> As I am hearing impaired I find subtitles essential for any video viewing. I can hear but have problems with some ranges of sounds that speaking forms part of. Without subtitles I'd be lost with videos. I also prefer videos to learn so it's a good way to assist me.

> I really appreciated the subtitles as sometimes I would miss a word or not know what it meant so having subtitles allowed me to look up the word later on.

> Subtitles were of great assistance. For me, listening whilst also reading the content in progress seems to enhance the comprehension. It's also particularly helpful when anatomical or medical terminology is being discussed – i.e. being able to see correct spelling on-the-spot within the captions (subtitles) rather than having to pause and then look up the word separately is very helpful.

> I really liked the subtitles option to the videos because it helped gain a better understanding of what was being said and [has]also been much better to jot down notes. I think this feature made a huge difference in my studies.

Key findings – recommendations

For effective production of a large volume of content, investment in infrastructure and staff at an institutional level is essential. Many university teaching staff do not have skills in digital communication and so part of this investment must focus on professional development for staff.

Some preproduction is strongly advised. Whether it's writing a script, preparing a presentation, organising locations or camera crew there are many considerations before you begin recording. It is advisable to employ digital audio-visual professionals to advise and support. The best policy is to ask for preparation advice and to request production assistance. In short, preparation, good design and practice are the key elements of a successful video. As mentioned above, there is some evidence that shorter videos are more engaging and a thorough preproduction process with effort put in to being concise will shorten the length of videos.

Making the switch to video-based content delivery is difficult for some staff who are used to longer lecture times, but a good way to organise your approach is to consider limiting each video to a self-contained concept or a topic. This way you build up a database of various topics and concepts, and this modular approach, while quite time-consuming to begin with, will mean less work as you may only have to update particular pieces of content and will be able repurpose it as a ready database of focused material to offer to students.

Consider making an investment in providing 100 per cent accurate same-language-subtitles. Taking this universally designed approach will make your content more accessible to a wide range of students in a variety of learning environments and allows students to exploit to inherent flexibility of the digital video format for their learning.

One of the key theorists in this field is educational psychologist Richard E. Mayer, whose cognitive theory of multimedia learning has relevance to this approach to creating effective content for students. Leverage the unique affordances of digital video to most benefit your students. One of the key ways this can be achieved is by having both words and pictures present on screen simultaneously. This is called the multimedia principle, which states that people learn better from words and pictures than from words alone (Mayer, 2017).

Be prepared for a change in the usual dynamic you experience as a lecturer/teacher. Developing an on-screen persona can be challenging for some, so plan to spend some time practicing and improving your new skill set. Results from our survey of students show that they find a mode of direct address to be the most effective. When asked "what sort of videos are the most effective for your learning?" (choose all that apply) they indicated an overwhelming preference for "a speaker presenting to the camera, with background slides," [n=239]. Guo, Kim & Rubin (2014) suggest this is due to "personalisation – the student feeling that the video is being directed right at them, rather than at an unnamed crowd".

Table 1: Student responses to a survey question on content video preference

Survey Question: What sort of videos are the most effective for your learning? (choose all that apply)	%
A speaker presenting to the camera, with background slides	88.28%
Recording of a computer desktop screen	40.59%
Case studies	35.98%
A speaker talking to the camera, without slides	25.10%
Interviews	24.27%
Recording of an on-campus lecture	23.43%
Other	10.04%
Don't know	0.00%

Creating videos can be effective for your students, but they are most effective as part of an overall course design in which the videos are just a part. A series of videos alone will not comprise an excellent course just as a great traditional lecture won't. Align your digital content with the overall aims and objectives of your course and use them to support active learner engagement.

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