

**Paper - Key Questions for the Effective Use of Video at City, a Literature Review by
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“How is video making a tangible difference in the higher education space, what impact is it having on student engagement with their course and learning, and perhaps most crucially, what are the measures of success of video use both for students and researchers?” (Carmichael, Reid, and Karpicke 2018, p.4)

There are two key sources for this paper, both are significant reviews of the literature that relate to the use of video/multimedia production for learning in HE. Firstly, the white paper “Assessing the Impact of Educational Video on Student Engagement, Critical Thinking and Learning” by Carmichael, Reid, & Karpicke 2018.

The key findings are:

1. Video is having an impact on learning through changes to pedagogy in HE with the development of the ‘flipped classroom’ approach
2. Video allows for greater student engagement, positive approaches to participation and motivation
3. Few references in the literature relating to the impact of video on knowledge development and critical thinking
4. Reference to Mayer’s work on “Cognitive Theory of Multimedia Learning” in particular their recommendations for interactions between the visual, audio and text and graphics for reinforcement (Clark and Mayer 2016)
5. Duration time for videos to be short, optimum time is 6 minutes
6. Personalisation of video content, students prefer to see and hear their tutors within the video and may display greater engagement with the course as a result
7. The use of graphics and visuals has not been shown to make a significant difference to the student audience and their resulting performance, although the authors recommend further research

**Analysis and implications for the LEaD offer of MILL Production and Educational
Technology Support**

We know that the changing university landscape is seeing the increase in the use of video with advances in Flipped Learning. In place of the traditional teaching approach, students will watch and hopefully become familiar with the video content ahead of

their class, with the timetabled session being given over to face-to-face and perhaps more interactivity with their tutors. Institutions in the USA have traditionally been pioneering in this approach, (Carmichael, Reid, and Karpicke 2018, p.7)

Blended Learning is generally known as a combination of mixed media and online resources and assignments, together with orthodox classroom activities. Blended learning permits new pedagogical approaches, often with video based activities, alternative teaching methods can 'make for a very beneficial learning experience and strong outcomes', this approach has shown to be clearly preferred by students (Carmichael, Reid, and Karpicke 2018)

Pedagogical Uses of Video

It is fair to say that the utilisation of video can provide significant and important differences to learning and teaching, especially when today's students have a wide diversity of educational experiences and expectations. For example, the challenge of re-imagining a traditional one-hour lecture can be viewed as 'disruptive pedagogy' (Kinash, Knight, and McLean 2015) with exciting opportunities such as creating short pieces of media content that could allow students to achieve greater levels of engagement.

One significant strategy would be to support problem-based learning where students are presented with issues in the form of video clips or visual stories that they have to solve. Video resources can also be created to form the contextual content and as a supplement to the academic materials, so to aid their collaborative work with fellow students.

This collaboration is one of the key features of the constructivist methodology where students in small groups take responsibility and ownership of their learning and with intuitive access to content. (Rasi and Poikela 2016)

Case Study. *As part of the work in the Educational Technology Team [LEaD] a series of videos have been produced to support a new module in the Cass Business School on Critical Thinking Skills. 12 separate pieces of media content are being used to inform students and provide a contextual story for a PBL [problem-based learning] approach to the course. Utilising both blended learning and flipped classroom methodologies; students will be expected to access, view and process the information from each video during the 10-week module as part of the curriculum.*

Benefits and impact of video use

In specific categories, such as science and particularly medicine, video has been shown to be of real benefit to students developing their clinical decision-making skills, changing preconceived ideas, improving cognitive learning and the retention of knowledge. (Carmichael, Reid, and Karpicke 2018, p.8) Video is often used for providing close-up views and previously unseen angles of view for certain medical procedures, specific equipment and simulation of operational requirements for practical applications and laboratory work. This type of visual example is invaluable where a verbal description would be inadequate or impossible, certainly in crowded practical sessions, only a few students would be in a position to obtain a reasonable view of the demonstration being carried out. (Ramlogan, Raman, and Sweet 2014) Some visual interpretations can be made with animation or even augmented reality, but this may be financially prohibitive in many cases. The belief is that a video can significantly improve the student's cognitive load without attempting to build a picture without images, or a 'mental animation' as would occur in a traditional lecture format.

Recent evidence shows that students have a preference for content created at their own place of study, even so far as showing a bias towards viewing content featuring their own academic tutors, such credibility seen as a connection with improvements to their learning experience. (Giannakos, Jaccheri, and Krogstie 2016)

Relevant highlights from the white paper by Carmichael, Reid, & Karpicke 2018:

- Video has a positive impact on engagement regarding widening participation
- The availability of online video adds to achievement and does not adversely affect attendance
- Across the literature, video has been shown to improve student satisfaction, they enjoy the independence it allows, for when and how to view the material
- Engagement with course materials has been demonstrated to be enhanced by the use of video within the curriculum
- With reference to Mayer's 'cognitive theory of multimedia learning' (Clark and Mayer 2016); **1.** There are two different channels for processing visual material and for processing auditory content**[see page 6]*. **2.** Each channel has a restricted capability for processing small amounts of information at any one time. **3.** Active processing is needed for learning to happen. Only when students engage with these three processes will 'meaningful learning' occur.
- The limitations of the working memory are eased by the ability to pause, rewind and repeatedly watch video. (Schreiber, Fukuta, and Gordon 2010)

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- Video is ideal for the ‘how to’ approach of imparting practical knowledge and demonstrating visual detail and context in more scientific and medical settings
- Video can aid student motivation; research demonstrates video helps with recall and comprehension, provision of different viewpoints, arousing interest and stimulating further research
- The most appropriate design of video content is vital for student motivation. Consideration of style, content and even delivery platform is essential for maximizing student motivation, affecting emotional responses and realising learning outcomes
- Mayer’s theory and design principles, with six key elements of multimedia learning (Clark and Mayer 2016) see appendix.
 - 1) Multimedia principle
 - 2) Modality principle
 - 3) Contiguity principle
 - 4) Redundancy principle
 - 5) Coherence principle
 - 6) Personalisation principle
- Video duration, the literature is unanimous that content should be short and average time should be about 6 minutes. Where there is a significant amount of content to be delivered, video segments can be created to be watch sequentially, which again aids the cognitive load and improves the processing and acquisition of knowledge
- Personalisation of video content. Research has demonstrated the value of academic staff being featured in media content, ‘social presence theory’ argues that valuable social connections are made and that these lead to a greater sense of engagement with the content and a positive impact on students (Hoogerheide, Loyens, and van Gog 2016)
- Graphics in video have not been successfully researched and where the authors have conducted initial tests on students, the results were not conclusive. Further evidence is needed to determine that embedded graphics significantly impact on learner engagement, positive cognitive processing and knowledge gains. (Carmichael, Reid, and Karpicke 2018)

Secondly, this paper considers the essay “Effective educational videos: Principles and guidelines for maximizing student learning from video content” by Cynthia Brame, CBE, Life Sciences Education 2016.

The key findings are highlighted here:

1. “To maximize the benefit from educational videos however it is important to keep in mind the three key components of cognitive load elements that impacts engagement and elements and promote active learning”(Brame 2016, p.5)
2. Video duration to be short and focused on learning aims
3. Use of audio and visual components to put across key explanations
4. The use of ‘signalling’ to identify significant concepts and ideas
5. The use of an engaging and enthusiastic narrative style
6. Embed video within the context of active learning with guidance, questions, interaction and assignments

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Brame sets out three key principles for video design and implementation:

- I. **Cognitive load**
- II. **Student engagement**
- III. **Active learning**

- I. **Cognitive load theory.** This is important for the design and production of video/multimedia content. The theory has it that memory has a number of components, sensory memory that is transient, this is processed in our working memory or stored temporarily, which can be encoded into long term memory. Our capacity for storage in our working memory, similar to RAM on a computer, is limited, so learners need to be selective about what their sensory memory should ‘save’ or give attention to, to retain in long term memory. (Sweller 1999, 1994, 1988)
 - a. Intrinsic load = material or understanding of knowledge that is specific to the subject of study
 - b. Germane load = level of cognitive activity required to achieve the learning outcome

- c. Extraneous load = the cognitive effort that does not help the learner reach the learning outcomes

Sweller argues that designers of video/multimedia should minimise the extraneous cognitive load and must focus on the intrinsic load of the subject, being mindful of when the content has a high intrinsic load. (Sweller 1999)

As mentioned previously, Mayer argues that our working memory has two channels for acquiring and decoding information*. Video/multimedia content should be designed to balance the cognitive load for both channels. The author recommends that effective video/multimedia content should 'minimise extraneous cognitive load, optimise germane cognitive load and manage intrinsic cognitive load'. (Brame 2016, p.2)

Signalling, which appears to be a simple method of highlighting key information for the learner, but being mindful of the germane cognitive load, content producers can emphasise how the content is organised and how data is connected. In addition to signposting, segmenting the content allows learners to digest the information in digestible pieces and allows them direct control of the flow of information.

Adding a level of interactivity can enhance this type of design, with clicks to progress once students have completed a section, thus balancing their intrinsic and germane load.

Weeding, this is a challenge as not all the information included is essential, but it may be interesting or enjoyable. i.e. music backgrounds, complicated backgrounds or visuals that are distracting. This is known as the extraneous load that may reduce the learning potential of a video/multimedia content.

- II. **Student Engagement.** The most important guideline for student engagement is to be strict about the duration of video content. Research has shown that the optimum duration for material is 6 minutes. As programme length increases, so too does student attention and their focus on the video/multimedia content. (Guo, Kim, and Rubin 2014; Risko et al. 2012) Referred to as the 'personalisation principle' or conversational style, (Clark and Mayer 2016; Brame 2016) the approach of using everyday language in video has been shown to improve learner motivation, as opposed to the more formal language

typically used in lectures. Mayer suggests that contrary to preconceptions about reading with a slow pace that allows students to keep up with the content, presenters and narrators should not talk slowly, be conversational in speed and sound as naturally enthusiastic as possible.

III. **Active Learning.** Numerous authors have shown that, ‘active learning in the classroom provides clear advantages over passive encounters with course material through lecture’ (Brame 2016, p.4) There was significant research carried out with science students answering questions interpolated with video content that showed an improvement in their learning outcomes (Szpunar, Khan, and Schacter 2013) Firstly, by complementing video with assessment, students were found to be able to optimise the cognitive load by reducing extraneous load, while increasing the germane load.

- Interactive features or click forward buttons within video/multimedia content as we know from Carmichael et al, can give students greater control over pace of their learning.
- Guiding questions can be successfully utilised when students are tasked with watching video content, these questions are prompts for learners to understand more clearly their learning objectives, it reduces extraneous load by focusing student's attention and therefore increase the germane cognitive load.
- Students who are given video assignments to create themselves have also been shown to display greater levels of engagement and contributed to higher levels of understanding of complex material. This could be seen as part of their self-evaluation and peer-group learning assessments. (Brame 2016)

In summary, the papers both confirm three key components for us to keep in focus for the effective use of video/multimedia for learning and teaching;

1. Cognitive load theory
2. Elements that impact engagement
3. Elements that promote active learning

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Appendix.

Mayer's Theory and Design Principles

As introduced earlier, the cognitive theory of multimedia learning (Mayer, 2014, Clark and Mayer, 2016) should prove instrumental in effective video design. It proposes that multimedia design should aim to reduce extraneous processing (cognitive processing that is not in line with learning objectives, caused by poor design), manage essential processing (necessary cognitive processing within the working memory that is affected by levels of complexity of the material) and encourage generative processing (cognitive processing for making sense of the material which is assisted by learner motivation). Absolutely, video developers need to consider this theory in their design choices. This paper outlines a brief description of the six, key principles of multimedia learning with additional principles being discussed in Clark and Mayer (2016) and Mayer (2014):

1. **Multimedia principle.** Providing words with pictures, images, or other graphics enhances learning relative to materials that include only words. While this principle pertains to texts with pictures, it also applies to videos, which include audio and video components.
2. **Modality principle.** When combining visual and verbal materials, it is more effective to use audio than it is to use written text. Videos may be more effective when they present video in conjunction with audio narration as opposed to written text in the video.
3. **Contiguity principle.** Multimedia materials are more effective when words and pictures/images/graphics occur in close proximity relative to when they do not occur in close proximity.
4. **Redundancy principle.** Eliminating redundancy enhances the effectiveness of multimedia. For example, text may be redundant with audio narration, and such redundant text should be eliminated.
5. **Coherence principle.** Adding flashy but unnecessary illustrations to multimedia can be distracting, reducing coherence and thereby reducing learning.
6. **Personalization principle.** Using a conversational style (e.g., in narration) can be more beneficial relative to a more formal presentation style.

(Carmichael, Reid, and Karpicke 2018, 12)