
Ten Key Factors for Making Educational and Instructional Videos

Scholarly and Research
Communication

VOLUME 13 / ISSUE 2 / 2022

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Abstract

Drawing on experiences in creating instructional videos for multiple projects, this reflective article discusses a ten-factor framework for the practical benefit of educators wishing to develop educational videos for audiences both within and outside of academic contexts. Informed by literature on best practices in video design from both cognitive scientists and other instructional video creators, the article emphasizes that there is no universal approach to making design decisions. The article explores key questions and tensions in the development process through a consideration of the elements of audience, purpose, resources, scripting, visuals, accessibility, interactivity, distribution, sustainability, and execution.

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Résumé

Cet article de réflexion s'appuie sur des expériences acquises lors de la création de vidéos pédagogiques pour de multiples projets. L'objectif de l'article est de présenter un guide en dix points en vue d'aider les éducateurs désirant créer des vidéos pédagogiques destinées à des publics tant académiques que non-académiques. Pour atteindre son but, l'article se rapporte à la littérature sur les meilleures pratiques en matière de conception vidéo provenant à la fois de spécialistes des sciences cognitives et d'autres créateurs de vidéos éducatives. En même temps, il souligne qu'il n'y a pas une seule approche universelle pour prendre des décisions sur la réalisation de vidéos pédagogiques. L'article explore les questions et les tensions clés de cette réalisation en examinant les éléments suivants : public, objectif, ressources, scénario, éléments visuels, accessibilité, interactivité, distribution, durabilité et exécution.

Keywords / Mots clés : audience, creativity, educational videos, production, teaching and learning / public, créativité, vidéos éducatives, production, enseignement et apprentissage

Introduction

Despite the rapid rise of video in education (Biard et al., 2018; Bétrancourt & Benetos, 2018), it is impossible to make an instructional video that satisfies often competing best

practices. However, intentional decision-making can overcome the tensions extant in creating educational videos. Drawing on our experiences in creating instructional videos for multiple projects, we present a ten-factor decision-making framework that guides our development process. This reflective article aims to demonstrate the downstream impacts of key decisions throughout the video-creation process. It outlines a practical framework of key considerations for instructors who are creating educational videos. The insights in this article did not result from systematic study but emerged gradually through first-hand experience in creating educational videos. The contributions of this article are therefore more practical than academic. Our experience is primarily in educational and instructional videos for projects created within an academic institution, but not necessarily designed for postsecondary audiences. Reflections from our experiences are supplemented with insights from the literature, with a focus on the design process and the tension between clarity and attention.

Literature review

The literature on instructional videos is expansive. A comprehensive review of all sources is outside the scope of this article (for reviews of the literature see Kay (2012), Giannakos (2013) and Poquet et al. (2018)). Two notable but often distinct bodies of literature are reviewed here: empirical studies often stemming from educational psychologists testing various aspects of instructional video design; and literature where video creators share insights on the production process. Other bodies of literature, specifically excluded, are studies with children (for a review see Fisch (2004)), and literature around MOOCs (Poquet et al., 2018; Bayeck & Choi, 2018; Davis et al., 2018).

Over the past thirty years, empirical studies have produced several well-established principles for instructional videos (Mayer, 2021). For example, the modality principle, which examines the interplay between visuals and narration, is based on 76 studies (Mayer & Fiorella, 2021c). At the broadest level, video is an important instructional medium because people learn better from a combination of visuals and narrated/auditory elements than from either of these alone (Mayer & Fiorella, 2021b). An abundance of empirical studies have generated lists of best practices (Mayer, 2021; Fiorella, 2021; Mayer et al., 2020; van der Meij & van der Meij, 2013). Moreover, a detailed examination of key principles is covered in the recent *Cambridge Handbook of Multimedia Learning* (Mayer & Fiorella, 2021a).

While the empirical literature provides an evidence base for decision-making about video design, the variety of purposes for instructional videos makes it difficult to aggregate findings (Bétrancourt & Benetosa, 2018). There is even a subset of studies attempting to generate classificatory schemes for educational video purposes and designs to address this problem (Bétrancourt, & Benetos, 2018; Chorianopoulos, 2018; Di Paolo et al., 2017; Hansch et al., 2015; Köse et al., 2021). Procedural or how-to type videos make up a disproportionate share of the empirical studies (Ou et al., 2019). More importantly, the literature is overwhelmingly based on laboratory settings as opposed to examinations from authentic learning environments (Fyfield et al., 2019). Concerns have been raised about the methodology and generalizability of some of these empirical findings (Castro-Alonso et al., 2019).

In contrast, there is a second body of material representing reflections and lessons learned from creators of videos (see Joseph et al., 2020), which are valuable given that these stem from pragmatic experiences. In many cases, creators have not relied heavily on empirical evidence (Rapchak, 2017). That said, there is some congruence for best practices between empirical literature and creator-focused literature. A notable example is the recommendation to keep videos short (Evans, 2014; Martin & Martin, 2015; Smith & Lee, 2017; Di Paolo et al., 2017; Guo et al., 2014; Hansch et al., 2015). Conversely, in some cases the empirical literature is at odds with creator best practices, such as those around accessibility. For example, the heavily researched modality principle suggests that narrated text should not also appear on screen except in limited cases (second-language material, technical terms) (Mayer and Fiorella, 2021c), but having captioning is essential for accessible design (Clossen, 2014).

While the empirical studies of educational psychologists and reflections of creators represent two distinct approaches to improving educational videos, neither is completely sufficient on its own. Effective instructional video design requires both an understanding of the science of learning theory and the creation process. This article adds to the literature by drawing on insights from both bodies of literature and first-hand experiences to provide a framework that highlights the tensions and contradictions that exist in design choices.

Our context

The authors' experience in developing educational and instructional videos stems from collaborating on two projects and a series of talks on video design. The initial collaboration was Opening Up Copyright, a university-funded project to develop a series of copyright literacy videos for students, staff, faculty, and the public. The project has resulted in over 30 videos, most six to eight minutes in length, addressing various aspects of copyright. We have previously discussed this project in terms of the challenges of relying on proprietary software (Joseph et al., 2019) and designing videos that are simultaneously engaging, reusable and precise (Joseph et al., 2020). Subsequently, we worked together on DigitalNWT, a multifaceted, multi-stakeholder digital-literacy project funded by the Government of Canada. For DigitalNWT, video became an effective way of providing educational materials after the rise of the COVID-19 pandemic. The primary audience for this project is remote northern communities with limited affordable and reliable broadband access. Through these two projects, this study used a range of video styles including scripted presentations, screen recordings of software tutorials, demonstrations of hands-on learning exercises, and even videos with puppets. Our work on these projects led us to being invited to give three different talks on video design in 2020 and 2021. The framework discussed below came out of insights that emerged as we reflected on our process for those workshops.

Our approach to design is also informed by our backgrounds. Julia Guy is a recent graduate of the combined Master of Digital Humanities and Master of Library and Information Studies program at the University of Alberta and is also a professional actor. In contrast, Michael B. McNally is an Associate Professor in Library and Information Studies. In this capacity and further informing our perspectives on video,

he teaches a class specifically on instructional practices, where video creation is implicated both in communicating material to students and as a student assignment.

Framework overview

While previous work on instructional video design has often focused on specific video types or contexts such as postsecondary-specific contexts (Costley et al., 2017; Valenti et al., 2019; Hibbert, 2014; Hansch et al., 2015), MOOCs (Davis et al., 2018; Poquet et al., 2018), or tutorials particular to library contexts (Rapchak, 2017; Weeks & Putnam Davis, 2017), the following framework is designed to be applicable to any kind of instructional or educational video. The framework outlines ten key factors of educational video creation and identifies key decisions that need to be made around each of these factors before the actual video creation begins. The factors are audience, purpose, resources, scripting, visuals, accessibility, interactivity, distribution, sustainability, and execution. The factors are arranged into four phases of video development: 1) Orienting the Project, 2) Content, 3) Usage, and 4) Production. In our experience, thoughtfully considering the central questions for each of these factors in advance ensures that educational videos align with the goals of the project and makes the production process very efficient. We also underscore the importance of ensuring that design choices either improve the clarity of the content or maintain the attention of viewers.

Phase one: Orienting the project

FACTORS: AUDIENCE, PURPOSE, RESOURCES

Key Questions:

Who is the audience for this video?

What is the purpose of this video?

What resources do you need for this video?

The first and most essential phase in educational video creation is Orienting the Project. This phase creates a North Star of sorts that can help guide the choices during the subsequent three phases (content, usage, and production). Orienting the Project involves meaningfully engaging with three fundamental questions: 1) Who is the audience for this video? 2) What is the purpose of this video? 3) What resources do you need for this video? The audience and purpose are paramount over all others. Establishing these elements early on has many benefits. For example, clearly defining the audience in specific terms can help inform all aspects of the scriptwriting process and accessibility considerations.

Audience

Although in many cases the audience may seem obvious (e.g., students in a class), there are situations where the audience is less defined, which requires making assumptions about prior knowledge. One of the most important factors to consider is the level of familiarity the audience will have with the topic. For example, technical terms and jargon should be limited (van der Meij & van der Meij, 2013; Clossen, 2014), unless the intended audience is very familiar with the subject matter. In some cases, the use of jargon may be necessary, and in this case an explanation of obscure terms should be provided. Designing for multiple audiences greatly increases complexity (Joseph et al., 2020). In both Opening Up Copyright and DigitalNWT, a broad audience was targeted and the level of prior knowledge for each topic was unpredictable. Segmenting or build-

ing smaller videos for Opening Up Copyright (currently a series of 32 videos) proved quite useful to enable advanced learners to access more complicated topics without having to work through the more introductory material.

Another important step is assessing the audience's motivation for watching the video (Mayer, 2021; Fiorella & Mayer, 2018). Being realistic about whether the audience will be invested in the topic, and therefore motivated to watch the video, can inform design choices. If the audience is anticipated to have genuine interest in the topic and to be motivated to watch the video, a longer video with a lot of detail is not necessarily a bad objective. Or, put in the language of the cognitive scientists, learner motivation increases generative processing capacity, which allows for a greater understanding of the material (Fiorella & Mayer, 2021). That said, it is beneficial to recognize that one's own interest in the topic may be quite different from the interests of the audience.

Creators should also consider the difference between a more captive audience of students for whom a video may be part of their coursework versus videos made for the general public. In many cases, students may only be motivated to watch a video because it is mandatory. Costley et al. found that making videos mandatory had a positive correlation with postsecondary students "at least beginning to watch" educational videos (2017, p. 200). Even so, it is best to keep mandatory videos brief and to the point to retain viewers until the end. The same principle is useful for audiences that are seeking a simple solution to a specific problem. Having a very short and engaging introduction or getting straight to the answer at the start of the video, rather than including a lengthy preamble, might prevent the viewer from closing the video and seeking the answer elsewhere (Di Paolo et al., 2017). Considering the audience and the motivations it has for watching the video serves as a means for anchoring both video content and the overall instructional purpose of the video.

Purpose

After identifying the audience in specific terms, the next step is considering what the video will provide to that audience. With regard to purpose, consider whether the video is intended to introduce, model, explain/inform, or provide feedback (Di Paolo et al., 2017). A video can serve multiple purposes for different parties simultaneously. For example, the purpose for the learners may be to compare two related concepts with examples, but the same video may also serve the purpose of building credibility for the instructor or promoting the organization/institution.

The purpose of a video might have both cognitive and affective elements. Cognitive purposes relate to what information needs to be understood by the audience and could also be framed as learning outcomes for learners. For the development of learning outcomes, it helps to use a framework such as Bloom's Taxonomy (Armstrong, 2010) as a starting point. Strong learning objectives inform content choices and ensure that a video stays on track. Communicating the learning objectives to the audience at the beginning of a video is also a key recommendation supported in the literature (Evans, 2014; Weeks & Putnam Davis, 2017; Lo & McCraw Dale, 2009; van der Meij & van der Meij, 2013) and helps prepare learners for what they are about to view. According to Morain and Swarts (2012), the most effective YouTube tutorials have "clearly forecasted

steps and objectives” (p. 11). If the video is hosted online, communicating the learning objectives also helps viewers to determine immediately whether the video is what they are looking for.

As for affective aspects of purpose, it is helpful to think in terms of what feelings the video should evoke in viewers. The purpose of a safety video might be to warn viewers of dangers but to ultimately leave viewers feeling confident that they can respond to emergencies appropriately. Other affective objectives could be to evoke feelings of belonging, curiosity, preparedness, reverence, excitement, or other emotions/moods. Getting specific about the desired affective impact will inform not only content choices, but also choices around language, tone, and visuals.

Resources

Video projects can range in size from a single short video to a series involving hours of content. Creators should critically assess if they have the equipment, software, time, money, and skills to undertake a large video project. Technological advances have contributed to an increasing ubiquity of video-recording options, and while studio-like production values are not required, quality audio recording equipment is important (Guo et al., 2014; Hansch et al., 2015; Hibbert, 2014). A recording space may also be required, and campus libraries, IT departments, or teaching and learning centres may have facilities to suit such a need.

Time is another key resource. It can take hours of work to produce a single minute of video (Bowles-Terry et al., 2010), with prior experience and desired production quality influencing production times. For Opening Up Copyright, it took nine months to produce the first two videos (each about six minutes in length), both of which were rebuilt at a higher quality later in the project. That same project has required hundreds of hours of graduate-student time along with regular input from a faculty member, librarian, and another subject-matter expert. The multi-year project work was financed through a series of grants totaling \$155,000 (CAD). Over 70% of the budget went to student salaries, and the project also developed a range of scholarly outputs (Opening Up Copyright, n.d.). It goes without saying that taking on a multi-video project can be an expensive undertaking. If development time is limited, there are only a few potential strategies beyond reducing scope. Quality video-editing software can make the editing process simpler but involving someone who has previously done video editing is even more effective. Similarly, production time can be saved, and the overall quality of the videos increased, by collaborating with those who have a skill set that some educators may not readily possess.

One outcome of having several students work through Opening Up Copyright was the discovery of another resource: skills. Not by design, the project ended up employing two students with professional acting experience (including Julia Guy). Having students with acting and voiceover experience resulted in higher quality videos and greater outputs. Voiceover is an example of a skill that may be at odds with professorial tendencies to speak extemporaneously (Hansch et al., 2015). It is worthwhile to assess the skills of the team and seek out people to help fill in gaps. If skills need to be developed by members of the team, that can also add to development time, and conversely,

involving students from the drama or theatre department may be a particularly effective approach. Assessing the skill level of the team at this stage helps ensure that the design choices made in the next stages are realistic.

Identifying the audience, purpose(s), and resources required makes it easier to develop videos that can strike the right balance between clarity and engagement. With audience and purpose carefully determined and all requisite resources in place, attention can be focused on video content.

Phase two: Content

FACTORS: SCRIPTING, VISUALS

Key Questions:

What information is essential?

How can you simplify?

How can you best use audio and images to convey this information?

What tone or style of speech fits your intended purpose?

Scripting

The content and visuals for the video can be planned in the script. It might be tempting to improvise wording and content for a video, and there are some situations where doing so makes sense. It may, for example, make the most sense to improvise if the speaker is very experienced in delivering the content or if there are huge amounts of video to produce, such as recording lectures for an entire semester at a postsecondary institution (as Michael McNally has done). It is also a mistake to script interviews, as they will come across as inauthentic and unengaging. In most cases, however, using scripts is recommended (Clossen, 2014; Weeks & Putnam Davis, 2017). Thoughtful scriptwriting helps ensure that nothing gets missed, allows for more efficient wording, and provides an opportunity to plan suitable visuals/audio.

The main question when it comes to scripting is scope. Scripts should be clear and simple (Weeks & Putnam Davis, 2017). Interesting but irrelevant material can decrease learning outcomes and redundant information should be avoided (Mayer, 2021). That said, in some situations, depending on the purpose of the video and the desired affective response, it might be worthwhile to include brief, engaging examples or anecdotes that, while not essential, may increase viewer interest. Content that does not significantly contribute to maintaining clarity or attention should be excluded.

The tone and style of speech used in an instructional video are other elements to consider when writing a script (and when recording later on). Although a natural and conversational tone is repeatedly underscored in the literature (van der Meij & van der Meij, 2013; Mayer, 2021; Martin & Martin, 2015), there is also value, depending on context, in presenting material in an authoritative and confident manner (Carter & Wiles, 2016; Moraine & Swarts, 2012). More than any other factor, the choices made about scripting are informed by the intended audience for the video. Indeed, the audience and its familiarity with a topic should substantially inform decisions around vocabulary and tone. Taking time to carefully word a script, read it aloud, and get feedback from others (particularly members of the target audience) is very useful.

Another important consideration during the scriptwriting stage is the organization and flow of ideas. Moraine and Swarts (2012) argue that most good instructional videos have a clear organizational structure. Research highlights the importance of segmenting or dividing videos into smaller sections (Humphries & Clark, 2021; Mayer & Fiorella, 2021c). Segmenting content into logical sections improves learning (Mayer, 2021) and makes new concepts more manageable for learners. Sections can then be arranged in a logical order, usually beginning with the broadest concepts and definitions and then getting into specific examples or exceptions. Organizing ideas in this way creates a map for learners to follow as they explore a new topic. In our experience, it is also advantageous to avoid long sentences. Meandering sentences are difficult for an audience to make sense of when they hear them (rather than read them), particularly if the audience cannot see the speaker.

Visuals

In the same way playwrights would include stage directions in their scripts, preliminary decisions about visuals should be planned at the same time as choices around scope, wording, tone, and organization. If the spoken words and visuals are developed simultaneously, these two elements are more likely to be cohesive in the final video. It is well documented in the literature that the audio and narration should be in sync (Mayer, 2021, p. 234; van der Meij, H. & van der Meij, J. 2013, p. 207) and planning these elements simultaneously ensures that they will line up in terms of timing and wording. In the end, effective communication is more important than production quality (Hansch et al. 2015, p. 6).

There are many visual choices to be made when it comes to video design. Do you want to use stock footage or record your own? Film a tutorial from a first- or a third-person perspective? Do you want to use direct address, where a teacher speaks straight to the audience through the lens? The literature extensively discusses dynamic versus static images (Castro-Alonso et al., 2019; Fiorella et al., 2019; ten Hove & van der Meij, 2015) and makes the recommendation, among others, to not use a static image of the instructor (Mayer, 2021). As a rule, dynamic visuals will hold a viewer's attention better than still images, and dynamic visuals are correlated with more popular videos on YouTube (ten Hove & van der Meij, 2015).

Having an instructor on screen is an area of considerable study and some contestation (Di Paolo et al, 2017; Kizilcec et al., 2015). While having the instructor facing the camera directly has been found to produce better learning outcomes (Beege et al., 2017; Fiorella et al., 2017), a mix of views may be more effective for how-to/procedural videos (Boucheix et al., 2018). In some cases, the instructor's presence can negatively impact learning (Fiorella and Mayer, 2018; Kizilcec et al., 2015), but instructor presence does increase engagement (Guo et al., 2014; Hibbert, 2014) and create a positive affective response (Wang & Antonenko, 2017). Also, there is consensus on the importance of the instructor, when he or she is on screen, making and maintaining eye-contact with the camera (Fiorella et al, 2019; van Gog et al., 2014), though at least one study contradicts this finding (van Wermeskerken & van Gog, 2017).

Gender can also impact how visuals are interpreted. As mentioned above, dynamic or moving visuals are often more effective than static ones, but this effect is much more

pronounced among male viewers than female (Castro-Alonso et al., 2019; Fiorella et al., 2019). The gender of the instructor does not seem to impact learning (Fiorella and Mayer, 2018), but it can have an influence on affective responses, with research finding that males may prefer male instructors (Hoogerheide et al., 2016).

Showing narrated text requires careful consideration, particularly in regard to the modality principle suggesting that narrated text should generally not appear on screen (Mayer & Fiorella, 2021c). Despite this principle, there have been a few instances in our own work where we have opted to include text on screen to help improve understanding. For example, in our videos about copyright, we included quotes from the Canadian *Copyright Act* or Supreme Court both in narration and on screen. This choice was made when the accuracy of the wording was relevant but the convoluted and meandering wording of the text would have been difficult to make sense of if only heard aloud. It is therefore our opinion that, in certain situations, even well-documented best practices may not make the most sense for learning.

Throughout the content phase (scripting and planning visuals), we recommend returning to questions of attention and clarity. If a scripting or visual choice fails to advance either attention or clarity, then eliminate it. For material where attention and clarity compete, determine if the gains in one are worth losses in the other. Finally, consider the repeated suggestion (from both creators and researchers) to keep videos short, ideally in the three-to-six-minute range (Di Paolo et al., 2017; Guo et al., 2014; Hansch et al., 2015; Evans, 2014; Weeks & Putnam Davis, 2017; Martin and Martin, 2015; van der Meij and van der Meij, 2013). While our viewer retention data from YouTube in Opening Up Copyright has suggested that you can retain viewers for up to eight minutes, being intentional with content is crucial. Equally important to content is thinking about the factors that influence how learners will use the video. The next section addresses these factors, as a consideration of how learner use must come before video production.

Phase three: Usage

FACTORS: ACCESSIBILITY, INTERACTIVITY, DISTRIBUTION, SUSTAINABILITY

Key Questions:

- How do you want viewers to engage with this video?
- How can you make this video discoverable by the target audience?
- How open do you want this video to be?
- What are the barriers that people might experience in accessing, using, or understanding this video?
- How will you know whether this video was successful?
- What might be the future uses of this video?

Accessibility

In the last several years, the accessibility of learning materials has taken on greater importance, to the point of being a legislated requirement in some cases (ADA Amendments Acts, 2008; Accessibility for Ontarians Disabilities Act, 2005). Making videos accessible requires having captions (of speech content and relevant non-speech content), and audio descriptions of visuals (Coolidge et al., 2021). Making underlying

materials, such as transcripts or slides, accessible in a variety of formats is also advisable (Courtney & Wilhoite-Mathwes, 2015; Martin & Martin, 2015; Weeks & Putnam Davis, 2017). The importance of accessibility is undeniable, but thoroughly considering accessibility presents several confounding aspects.

As mentioned earlier, the accessibility principle of captioning stands in sharp contrast to the well-established modality principle. Another accessibility recommendation, having audio descriptions of visual materials, also militates against the modality principle (Mayer and Fiorella, 2021c). Another complication is that making a video accessible and usable requires more resources, skills, and considerably more effort and will on the part of instructors (McNally & Christiansen, 2020). It should be stressed that accessibility considerations should not be done as an afterthought. The decision on whether to add subtitles, for example, needs to be made early. Deciding early will prevent the placement of text or important images at the bottom of the screen that would end up being covered by subtitles in postproduction.

Arguably, certain common approaches, such as including closed captioning, do not go far enough in removing barriers to instructional materials (Rogers-Shaw et al., 2018). Stemming from Ron Mace's Seven Principles of Universal Design in architecture, Universal Design for Learning (UDL) aims to eliminate ableism in education by allowing for multiple modes of engagement and formats of materials while eliminating barriers (Clossen, 2014; Rogers-Shaw et al., 2018). For example, Clossen (2014) emphasizes the value of considering whether a mouse is needed for navigation and whether the platform hosting the video supports screen readers. The decision to fully embrace UDL should be weighed carefully as it requires a significant commitment and may make the video less effective for some viewers.

Design choices in relation to accessibility and UDL relate to another important trend in educational material, the ascent of open educational resources. In the case of Opening Up Copyright, openness was a foundational concern given that one of the project's goals was "producing open educational resources (OER) about copyright that can serve as an enabler for other open education projects" (Opening Up Copyright, 2022). We discovered that designing to increase openness often resulted in increased accessibility (though not necessarily at the level of universal design), a finding that was also emerging in the literature at the time (Thomas, 2018; McNally & Christiansen, 2020; Zhang et al., 2020). For example, providing the slides and transcripts for the videos not only aligned the project with best practices for the creation of open educational resources but also increased accessibility by providing content in different formats.

Interactivity

By default, video is a passive medium that contrasts with the growing emphasis on active learning in educational contexts. Integrating interactivity is a recommendation made throughout the literature (Lo & McCraw Dale, 2009; Martin & Martin, 2015; Smith & Lee 2017). Interactive videos can be a means for increasing engagement (Davis et al., 2018) and including interactivity is also important for ensuring that a video actually facilitates learning (Martin & Martin, 2015). Notably, interactivity can also be used to incorporate assessments, through for example the inclusion of a sum-

mative quiz at the end of a video, which also benefits learning (Mayer, 2021; Mitrovic et al., 2017). Nonetheless, interactivity is not a common feature of educational videos (Fyfield et al., 2019). This is likely because there has been relatively little innovation in video playback interfaces, and so the option to pause the video remains the most common user-control ability (Tuncer et al., 2020).

While integrated pauses can prevent cognitive overload (Tuncer et al., 2020), improvements to learning are not universal, and automatic pauses (as opposed to user-controlled pauses) are not necessarily beneficial (Biard et al., 2018; Fiorella and Mayer, 2018; Merkt, et al., 2018). However, it may be beneficial to direct viewers to pause the video to conduct an action outside of the video. In the case of DigitalNWT, some videos included clear instructions to pause before an activity that required a paper workbook (“You can now pause the video to complete the activity”). This allowed for active learning in a non-digital context.

The disuse of digital interactivity often results from software limitations. While proprietary software options such as Articulate Storyline and Adobe Captivate can be used, the open source interactive H5P overlay is becoming increasingly popular. To simplify H5P integration, there are growing libraries of open resources, such as eCampus Ontario’s H5P studio (eCampusOntario, n.d.), that can be directly incorporated or adapted onto videos. Opening Up Copyright has relied extensively on H5P, which has proven useful to facilitate modular design and improve editability (Joseph et al., 2020). The easily editable H5P layer has also been used to include optional pop-ups, to provide links to supplementary resources, and to include quizzes for assessment at the end of videos. The goal of these optional assessments was to reinforce learning objectives rather than to serve as a cognitive assessment of learning; the project rarely relied on assessment data for evaluating learning.

Distribution

At the outset, distribution, or how the videos are delivered to learners, may not seem like a salient or important consideration, but it has several important implications. In many cases, distribution may be constrained by institutional factors, such as a requirement that videos be placed in a learning management system. That said, if the goal is to reach learners outside of postsecondary classrooms, there may be multiple options for distribution. In the case of DigitalNWT, our learners often faced limited broadband access and high data costs that would inhibit the use of streaming and downloading videos (for a further discussion of broadband challenges in DigitalNWT, see McMahan et al., 2021). To address this, videos were mailed to northern communities on USB sticks. In most situations, however, optimal distribution would not include trips to the post office, and instead would involve hosting and circulating the videos online.

YouTube and similar video streaming platforms offer several benefits, including closed captioning, usage analytics (although an alternative would be Google Analytics (Evans, 2014)), and high discoverability in search results. While distribution platforms such as YouTube can provide viewership statistics, these can be misleading as views do not accurately reflect viewer retention (Altman & Jiménez, 2013). The use of commercial platforms like YouTube can also introduce other challenges. For example, a more care-

ful consideration of which media can be incorporated in terms of copyright, particularly when it comes to audio, is required. YouTube's Content ID is well documented for facilitating overreach by rights holders (Edwards, 2018). In the case of Opening Up Copyright, YouTube has specifically flagged that the videos cannot be used to generate revenues because of a claim by the rights holder for the music used in the credits. This prohibition exists even though the videos are not monetized, and the music was originally made available via a Creative Commons Attribution (CC-BY), which allows for commercial uses. Educational material hosted on YouTube is also less likely to generate significant viewer interaction as one study found that on average 200 views were needed to generate one like/dislike, and the comment-to-view ratio was 1 to 1600 (Liikkanen, 2013). Alternatively, institutional repositories as well as domain- or format-specific repositories (such as OER Commons for open educational resources or Merlot for openly licensed multimedia resources) should also be considered, as these options provide alternatives to commercial platforms such as YouTube.

Sustainability

Sustainability of video resources is an underdeveloped aspect of the literature that has emerged as a significant consideration in both Opening Up Copyright and DigitalNWT. Video creators need to consider the longevity of resources and whether their video may need to change or be replaced over time. A recent study calculated the average lifespan of educational videos to be 5.74 years (Espino et al., 2021). Sustainability is influenced by several factors: digital content ages at different rates, and, in the case of DigitalNWT, software or app-related materials age quickly. Screen recordings of technical tutorials made through Windows 10 can already be considered out of date. In the case of DigitalNWT, the changing team also impacts sustainability. The use of students as narrators (including the professional actor Julia Guy) made for high quality narrations; however, as the same students have graduated, to make even minor changes to the narration requires a complete re-recording of the audio by someone else to keep it consistent.

Enhancing the lifespan of video requires careful consideration of sustainability before the start of production. Espino et al. (2021) recommend keeping editable video sources, segmenting content to multiple videos (to reduce the burden of future editing) and avoiding heavily tying a video to specific brands or authors. In our own work, we have realized that choices made in scripting can better future-proof the resulting videos. In the case of Opening Up Copyright, scripts started to be written using more specific language (e.g., "2020" as opposed to "this year") so that information would not become inaccurate for future viewers. Also consider using more easily editable aspects such as H5P to provide information that may change. More importantly, careful consideration should be given to the use of the instructor's presence. The onscreen appearance of an instructor is difficult to manipulate in comparison to narration over images. Finally, before setting out to create a video or series of videos, one should determine if video is even a suitable medium or if frequent content changes will quickly render materials useless.

The usage factors discussed above are closely related to design choices that will enable or inhibit certain approaches. Consideration of these factors in relation to attention and clarity also presents greater tension than in the first two phases. For example, adding interactivity may increase attention but negatively impact accessibility and con-

strain distribution. Although trade-offs exist, elucidating these before beginning production allows one to actively shape the use of a video rather than being constrained afterwards.

Phase four: Production

FACTOR: EXECUTION

Key Question:

How can you ensure continuity and an effective use of time?

Execution

At this point in the process, key decisions around audience, purpose, resources, visuals, scripting, interactivity, assessment, distribution, and sustainability will have been made and a very detailed plan for the video content and design will have emerged. The last factor to consider is how to execute the task of recording and assembling the video. Recommendations for this factor stem primarily from our experience creating videos and focus largely on developing a realistic schedule and ensuring continuity. When planning filming or recording, one must be realistic about how much time the procedure will take and to leave ample time to set up, test, solve issues, and do multiple takes. It is also more time-effective to schedule filming by location rather than filming scenes in the order in which they will appear in the video.

Accounting for continuity involves preventing distracting inconsistencies to make sure that the video will be cohesive. One way to do so is to test a recording location and time of day in advance to ensure that there is consistent lighting and minimal background noise. Keeping track of items or props that might be in the shot is also a good strategy (think of the Starbucks cup in *Game of Thrones* as an example of what not to do). Lastly, keeping the camera or microphone in a consistent position and at a consistent distance from the subject will also ensure consistency when multiple shots are edited together. When possible, all audio should be recorded in the same location to prevent distracting changes in background noise and volume.

It is worth briefly mentioning another key aspect of the execution, editing. Getting into the specific steps of editing a video project is beyond the scope of this article; however, some recommendations to keep in mind include keeping visuals dynamic rather than static as this might produce better learning outcomes (Fiorella et. al., 2019), ensuring that narration is in sync with animation or visuals (Mayer, 2021; van der Meij, & van der Meij, 2013) and, where possible, eliminating extraneous audio, background music, or ambient noise as they can hinder learning (Rapchak, 2017; Mayer and Fiorella, 2021c).

Concluding reflections

Creating educational videos, particularly for non-classroom audiences, requires an intentional consideration of numerous factors, several of which work at cross purposes. While guiding questions around audience and purpose should complement each other, decisions around attention and clarity will often be in competition. For key decisions, empirical literature provides important insights on the science of learning from video, and reflections from creators can inform video production. The most crucial recommendations we can make to other creators of instructional videos are to consider the ten factors

described in this framework before beginning production and to prioritize the audience and purpose of the video when at an impasse. It is easy to get distracted during the development process, but ultimately a video is successful if it is appropriate to the audience and fulfils the purpose it was designed for in the first place. Experience in instructional video design takes time to accrue, but it leads to an appreciation of the downstream impacts of key decisions and ultimately the development of better instructional videos.

Video has long been heralded as a means to revolutionize education (Mayer & Fiorella, 2021b), but at its core it is simply another educational medium. As with any kind of teaching, there is no one best approach to making instructional videos. There is a plethora of future research areas to explore to advance the field (see Fyfield et al., 2019 for a critical discussion in this regard), but it is essential to recognize that video will never displace the millennia of humans teaching and learning face to face.

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