

The Engineering Roadshow: Creating engaging engineering education video resources

Julian O'Shea^a & Nick Brown^b.
Monash University^a, RMIT University^b
julian.oshea@monash.edu

ABSTRACT

CONTEXT

The way in which engineering students are learning is changing; there has been an increase in blended learning and correspondingly engineering academics are producing asynchronous video-based learning resources. Concurrently, there has been an increase in educational content on social media platforms such as TikTok and youtube driven by what Amos (2021) describes as, “free choice learners”, that is people that aren't required to watch educational content but choose to do so. The opportunity exists to learn from social media style video production, especially on-location filming, to improve university engineering education videos.

PURPOSE

This study investigates how engineering student learning could be improved by developing video resources influenced by social media style video production techniques. At the same time understand the mutual benefits of social media curators collaborating with engineering educators.

APPROACH

The researchers identified interesting engineering exemplars and sites Melbourne, which included a water resource facility; end-of-life mining facilities; and a small-scale hydro-electric power plant. At each site a video was made demonstrating an engineering principle in action. These videos were then edited and integrated into a large-scale engineering course that teaches fundamentals. Versions of these videos were also shared publicly on social media for a wider, public audience with viewing statistics, and qualitative feedback assessed.

OUTCOMES

An engineering roadshow pilot visiting sites of interest was conducted. Overall only four video resources were produced. In part this was down to the time required for the academic to perform their editing. The videos produced were highly viewed in the public domain and more videos are to be released for future deliveries. Students appreciated videos showing ‘engineering in action’ examples. Further investigation is required to determine the influence of this production method on student learning outcomes.

SUMMARY

The engineering roadshow presented a distinct opportunity to use ‘on site’ filming to expand and enhance engineering education materials. While the process does take time, skill and some resources, it was an enjoyable and positive experience to take part in. There is an opportunity to learn from educational social media video creators to guide best-practice in some aspects of engagement and production.

KEYWORDS

educational video, social media, engineering education, creator academic

Introduction

Blended learning, the complimenting of synchronous educator led learning with asynchronous learning resources, is not a new approach, see Garrison and Kanuka (2004). However, the adoption of blended learning by universities has accelerated following the development of significant online learning resources during mandated closure of campuses resulting from the COVID-19 pandemic (Banihashem, 2023; Giesen, 2022). Universities in states like Victoria (Australia) essentially had two academic years of fully online learning (2020 & 2021), enforced by over 260 days of stay-at-home orders. Once the stay-at-home orders lifted universities in states with high COVID-19 case numbers, such as RMIT University and Monash University, didn't fully return to large face to face lectures. In part due to the public health risk of having hundreds of students seated in lecture halls. During this time 'lectures' were being shared asynchronously as video-based learning resources, materials that primarily combine audio (e.g., narration) with visual elements such as images (static and video) as well as graphics, or animations.

Whilst the *use* of video-based learning resources increased over the COVID-19 lockdowns the quality or educational value of these videos was mixed. Anecdotally, engineering educators favoured the 'head over PowerPoint' style, mimicking a face to face delivery. The authors even noted in 2020, academics uploading lecture theatre capture recordings from the previous year. The increase in use of video-based learning resources has led to guidance on how to make educational videos engaging, see Guo et al. (2014); Dart and Gregg (2021); Collins (2022), including tips on video length, style, platform etc. Less well investigated are the mechanisms to identify, capture, and present relevant video resources.

At the same time as the rise in video-based learning resources in universities there has been significant growth in educational content outside of universities on social media platforms such as TikTok and YouTube which have over seven million Australian users (Mason, 2022). These platforms have enabled what Amos (2021) describes as, "free-choice learners", that is people that aren't required to watch educational content but choose to do so. With university educators choosing (or being forced) to develop engaging video-based learning resources, and social media content creators already producing materials which people are choosing to engage with, the opportunity exists to understand how practices and experiences from social media style video production may enhance engineering education video-based learning resources. At the time of this initiative author 1 was both a digital video creator and academic, looking for interesting engineering and design topics for free-choice learners (not for course content). Author 2 was an academic coordinator of a large foundational engineering course, with plenty of case studies and a drive to create engaging videos, but poor video production skills. The authors agreed to collaborate, share knowledge and experience and support each other to generate engaging engineering videos using examples and case studies from their local area. This paper reports on the initiation of this collaboration, which ultimately led to 'The Engineering Roadshow' as a concept to generate engaging content. This paper shares lessons learnt and provides proof of concept through reflections by both author 1, the creator, and author 2 the academic.

Approach

Conversations between the authors identified relative strengths and benefits from a potential collaboration. From the academic perspective a key objective was to explore alternative formats for videos, not to replicate the style of lectures (a style which educational social media video rarely adopts). Traditionally, in a time of lectures, engineer educators may engage learners through taught case-studies, or by bringing in a guest speaker, a professional engineer who can share some of their experience. This style is very applicable to engineering education with engineering being about taking concepts and putting them into the real world. That means that most of the examples of engineering, are out in the real world. With asynchronous learning there is the opportunity to take the class 'virtually' out to the real world. To prove the concept of the collaboration the scope was set to using engineering exemplars filmed 'on location' to explain a

particular engineering topic or concept. Author 1 (the creator) would use filmed exemplars to engage free choice learners (not as course content) and author 2 would use exemplars as course content.

Developing The Engineering Roadshow Concept

The authors identified 36 'sites' of interest around Victoria which contained an exemplar that helped explain or explore an engineering topic. The sites were identified through the authors own knowledge, as well as online sources such as the Engineers Australia Heritage Register <https://portal.engineersaustralia.org.au/heritage/search>. To keep track of these sites, a shared document held key information including the engineering concept it helped explain and key facts; a shared map captured each location. On review the sites fell into three categories:

1. public-accessible (free) e.g. Silvan reservoir,
2. private-accessible (paid) e.g. black box situated at Melbourne museum
3. private-not accessible e.g. Interscan Landing System at Melbourne Airport

Each of the 36 sites were evaluated by both authors for their relevance to their respective audiences. Whilst the engineering students had chosen to study engineering, whereas the free choice learners could come from any background, there was no expectation that either audience had a firm understanding of foundational engineering principles. In fact, the intention of both authors was to increase the levels of interest and passion for engineering. This meant that the shortlisted sites were of interest to both authors and were deemed high priority. Only sites coded as 'publicly accessible (free)' were considered as the initiative was being self-funded and approvals to film in say a museum could be complicated. Nine sites were shortlisted. Filming at each site needed to be scheduled with limitations meaning visiting as many sites as possible in a short 'sprint'. This led to the concept of an 'engineering roadshow', visiting the sites via car, and each author making a video on the exemplar for their audience. A general direction for the pilot 'engineering roadshow' was determined, based on the shared preference of both authors to prioritise the *Eldorado Dredge* site. This decision meant two sites were removed (due to detours) with one new site (*Rubicon Power Station*) added after further research into potential sites situated close to the planned route. Whilst filming at the final eight sites was the plan the team also kept an open mind in identifying interested sites on the way.

The Engineering Roadshow Pilot

The pilot engineering roadshow initially consisted of eight exemplars located at eight sites, shortlisted for their relevance to both students enrolled in a first-year foundational engineering course and free choice learners, as well as their proximity to the engineering roadshow route. In reality, once on the road adjustments were made on the fly to the plan, sometimes enforced (e.g. closed sites) as well as out of choice. Each author conducted their own research to develop key talking points for each exemplar. Each author delivered an improvised narrative at each site based on those talking points. As the sites could not be scoped in advance, specific filming locations or filmed scenes other than the narrative were not planned (i.e. there was no storyboard) and instead all filming decisions were made on site. A narrative style is used below to explain how the engineering roadshow actually played out.

Site 1: Silvan Reservoir (Silvan)

The intended first site, the Silvan Reservoir, was chosen as an exemplar of Melbourne's protected drinking water catchments. The site was of interest to free-choice learners as Melbourne is unique in being a city that still uses protected catchments. For the university students the site demonstrates the work of environmental engineering and demonstrates how to solve a problem in a different way (i.e. protection not treatment).

Unfortunately, the planned site was inaccessible due to weather damage. Both authors made their videos in front of signs and other infrastructure that was evocative of the location. The authors drove to a different viewing point where the protected catchment could be seen and

author 1 recorded another video with the reservoir in the background. The fact this was the first site of the trip meant more time was required to set up the equipment and for author 1 to provide training to author 2. This combined with the need to record at a second location delayed departure to the next site. The lesson learned was to plan ahead, potentially contact someone who might be familiar with accessibility.

Unplanned Site 2: Maroondah Reservoir (Healesville)

On the way to Rubicon Power Station the authors passed Maroondah Reservoir and decided that it could provide some establishing shots that could not be filmed at Silvan Reservoir due to the closure of access to the site. This stop led to a major insight of the pilot. Whilst accessing the reservoir the authors discovered a sign explaining how the dam had been retrofitted to resist higher loads caused by severe flooding. A basic engineering explanation was provided by the sign. This provided an excellent unexpected exemplar, author 2 made a video about engineers retrofitting infrastructure to be climate change resilient.

Site 3: Rubicon Power Station (Rubicon)

Located about 40km North-East of Melbourne the Rubicon run of the river power station is a good example of changing demand and the role of engineering in meeting this demand. The power station currently provides 0.02% of Victoria's power, down from 17% when it was first commissioned 100 years ago. Both authors made videos about this site. A challenge was that the site had no internet reception and both authors speaking notes were on a cloud-based service. This meant both authors had to deliver their pieces from memory and using information available on the site. Accumulated delays during the day meant this was the last site to be filmed on day 1.

Unplanned Site 4: Banalla Climate Project (Banalla)

This was an unplanned site triggered by passing a sign explaining climate change mitigation initiatives underway in the town of Banalla. Both authors made videos on the banks of Lake Benalla on the climate change mitigation efforts. The signs on site were valuable but a lack of time to prepare or research meant the segments filmed were not as good as they could be.

Site 5: The Eldorado Dredge and Bridge (Eldorado)

This site was planned with both authors making multiple videos on different aspects of the dredge. For engineering students, the focus was on decommissioning, the idea that the dredge had been abandoned, and needed further engineering works to now prevent it from becoming an environmental hazard. One big takeaway from this site was an interaction with a local couple who were also visiting the dredge. They asked about the initiative and after explaining, they said they knew that a person who worked at the Banalla visitor centre had been involved with the climate project and we should really speak to them if we wanted to learn more. This was insightful as we had not thought about asking at local information sites for inspiration or ideas for other sites to film on the fly. Whilst it was too late to go back to Banalla we made a note to consider this and then asked a few people in Eldorado if they knew of any other sites.

Talking to an Eldorado business owner, who was familiar with local heritage they told us of three other sites of interest, including a culvert, a swing bridge (which we knew about) and a gold processing facility. On inspection of these sites, only B-roll style videos were taken as the sites were interesting, but the authors could not find a link to the engineering topics they were interested in. This was the downside of having limited time to identify relevance.

Unplanned Site 6: Wangaratta (Wangaratta)

Inspired by the couple at the Eldorado dredge, the authors diverted to Wangaratta and visiting the town's information site. The visitor centre team were unfamiliar with engineering sites and it was difficult to explain the sorts of sites we were interested in visiting. This led to the insight that we needed a better way to explain to the public what we were doing and what we were looking for to be able to take advantage of local knowledge.

After a preliminary scout around Wangaratta no sites of interest could be identified. At a natural stopping point the authors brainstormed some more ideas. Taking advantage of the fact there was a person to hold the camera both authors made videos, author 1 on BBQ's in public spaces and author 2 made a video about engineering knowledge in the world using examples of tire pressure readings and fuel indicator arrow.

Further sites

There were another five sites that were planned, the majority of these were in metropolitan Melbourne. The concept was these would be filmed on return from the second day. In reality the filming at these sites was abandoned as part of the roadshow pilot with the rationale being they could be filmed at another time and the authors both feeling low on energy and enthusiasm after two full days of travel and filming.

Summary of major insights

Completing the engineering roadshow pilot produced several insights and lessons learnt. These can be summarised as:

- Check or confirm access. Significant delays to filming were experienced because a site was closed to the public. Call local visitor information to identify issues.
- Certain locations may require filming from certain angles, if this is the case plan ahead to ensure these sites are visited when sunlight will not detract from the scene.
- Take printed speaking notes as back up.
- Consider setting up interviews with local experts ahead of time, people who can speak to the project.
- Have a way to explain to the public the initiative and get them involved.
- Traveling and filming in this manner can be very tiring. Ensure there is reasonable time to complete the schedule, especially if filming in summer or warmer months.

In addition to the reflections and lessons learnt from the logistics side, each author independently reflected on the roadshow and considered what they would do differently.

Additional Reflections from the Academic

The academic, author 2, coordinates a large first year foundational course that utilises project based learning and blended learning. Before the engineering roadshow pilot all video-based learning resources for the course were either 'head over PowerPoint' recordings or similar, narration style and heavily slides based. In 2022, students completing the standard course experience survey indicated that the teaching materials would benefit from a refresh. This contrasted with student's responses in 2020 and 2021 (lockdown years) which indicated that students were impressed by the way the online resources for the course had been generated. The inference here is that the course did a good job at initially adapting from face-to-face lectures to online asynchronous materials but then failed to keep evolving, and that the video resources required a refresh. This was part of the original drive for author 2 to engage in the collaboration.

Only two segments from the engineering roadshow pilot were fully edited and formed into a case study that was presented to students through the learning management system. This was less than expected and reflects the large time requirement for editing and integration. Insights from the filming and editing stage include:

- Being on location with an experienced creator was invaluable as they could identify errors in narration in real time, and more importantly give guidance on how to correct mistakes. The 'on the job' training was valuable, and I made fewer mistakes on the final recordings.
- Whilst the intention of the engineering roadshow pilot was to film things that were location specific we ended up also filming other scenes (e.g. car stickers) which were not location specific, but because we were warmed up, had the gear, had a camera operator.
- Mistakes will happen and identifying them on location rather than in the editing suite is valuable. I did not have the skills to be able to cut out some of the mistakes I made in the editing suite.

- I would recommend filming multiple takes and delete the bad ones on location (whilst it is still fresh in the mind) rather than one long take and then having to make edits in an editing suite. One of my biggest lessons learnt was how long editing takes; reducing post-production time by doing as much of the work on location can reduce this time.
- One challenge was the ability to do the post-production edits on the standard work issued laptop. I had to use a purpose-built recording studio on campus, however this could only be reserved for 2-hours at a time and was often booked by other users.
- As I was editing I realised that I was creating the script I wanted to have read out on location. On reflection, I would have liked to prototype scripts prior to being on location.
- One unexpected, but happy, consequence was the added motivation for teaching engineering. I went into the semester feeling more engaged and enthusiastic.
- The engineering roadshow also inspired me to try different forms of video production in the editing suite including using a lightboard for demonstration and a greenscreen.

The new video-based learning resources, were incorporated into a course delivered in the first semester, 2023. Reflecting after the delivery revealed:

- One unintended consequence of moving away from head over PowerPoint is that there is no natural 'slides' to give to students. Comments on the Course Experience Survey indicated students would like to have some summary or handout materials.
- Informal feedback from students indicated that they liked how some of the new video resources gave them a greater exposure to engineering in the real world.
- Providing 'real world' context was also one of the most frequent comments that students left in the formal course feedback, however further investigation is needed to understand if this is due to the new materials or the Project Based Learning style.
- Using analytics on the videos that were produced didn't produce any noticeable insights. In general video viewership dropped off over the semester and, maybe unsurprisingly, the videos that related directly to graded quizzes were the most viewed. To understand if the videos are engaging and effective at teaching a further study is required.

Reflections from the Creator

The engineering roadshow pilot provided the opportunity to film "on-location" at sites that were outside the local city area or did not use the 'green screen' effect. To date, two videos from this roadtrip have been released onto TikTok, Instagram and Twitter. The two videos (O'Shea, 2023a and O'Shea, 2023b) are both themed on water quality. Each of these videos is a vertical short video, watchable in the scrolling video feed. On many platforms including YouTube, Facebook and Netflix, viewers 'opt in' to watching a video, by clicking, based on the title, thumbnail or short autoplay. This is functionally different from the full screen scrolling experience of TikTok and Instagram Reels, where viewers are algorithmically served videos, which automatically start playing. At this stage viewers can continue watching or scroll up to the next video. As such, the audience might not have a pre-existing interest or knowledge of the topic being discussed. Falk (2005) notes that the motivation for these free-choice learners are varied and may be to, "satisfy a personal sense of identity, to create a sense of value within the world, and to fulfil personal intellectual and emotional needs". Key to this, is they are not motivated by a grade on gaining knowledge to directly contribute to an assessment.

Social media video outcomes

Video 1 (O'Shea, 2023a), *This fence is why Melbourne water is so good*, explains the water catchment system in operation in Victoria (Australia) and how it means the water requires less treatment than alternatives. This video was published on Instagram on 14 February 2023 and TikTok on 15 February 2023. Since then the video has received 366,600 views, 32,000 likes, 914 comments and has been shared 3,358 times on TikTok (TikTok analytics at 4 August, 2023). These viewers were predominantly Australian (83.2%) with US (1.7%) and Singaporean (1.4%) audiences the next most common. As outlined above, the vast majority of these viewers (94.6%)

saw this video via the ‘For You’ feature, that is algorithmically served by TikTok, rather than people that actively follow this account. The total watch time on this video was 3,489h:15m:50s (TikTok analytics at 4 August, 2023). This video out-performed other recent videos, demonstrating it was an engaging topic or video. On Instagram this video received 269,555 views; 10,151 likes; 337 comments; and was shared 5,783 times (Instagram analytics at 4 August, 2023). Similarly to the TikTok video, the vast majority of these viewers (254,000) were not followers of the channel and were served this video algorithmically in the Reels video feed (Instagram analytics at 4 August, 2023). View counts are prominent metrics on social media, but are something that different creators value to vastly different amounts (Hill et al., 2022).

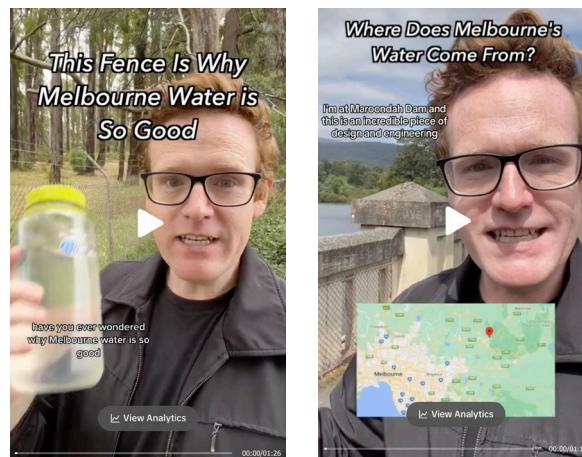


Figure 1 – Screenshots from the online videos (O’Shea, 2023a and O’Shea, 2023b)

The comments on this video were largely about the quality of water in Melbourne in comparison to other places with many (but not all) of the comments commenting that this water compares positively to other places. A small number of comments made reference to the video itself and some indicative comments are as follows.

“Thats so interesting! I live walking distance to Silvan reservoir and now feel privileged 😊👍” - TikTok comment

“Fascinating! TIL [today I learned], thank you! Cheers! 🙌” - TikTok comment

Notably, some comments on this video were negative, and included disinformation, particularly around the use of fluoride and the safety of the water.

Video 2 (O’Shea, 2023b), *Where does Melbourne’s water come from?*, is a video that shows and explains Maroondah dam and the role it plays in fresh water collection with an explanation of some of its design features. The video was published on both Instagram and TikTok on 15 June, 2023 receiving 48,700 views, 3,144 likes, 53 comments and 138 shares on TikTok (TikTok analytics at 4 August, 2023). The demographics (87.4% Australian) and section (89.8% For You page) are similar to the previous video (TikTok analytics at 4 August, 2023). This video had a reach of around 10% of the previous one, showing how significant the impact of the algorithm, based on watch behaviour, is. On Instagram, this video received 69,656 views, 3,383 likes, 80 comments and 451 shares (Instagram analytics at 4 August, 2023). On both TikTok and Instagram this video performed in line with normal engagement compared with other videos.

The most common comments on this video were focussed on the natural beauty of this area, and the quality of the water in this region.

“Some of the best quality drinking water anywhere in the world thanks to that closed catchment ❤️” - Instagram comment

“We went there recently it's lovely” - Instagram comment

One comment, although likely somewhat in jest, speaks to how this type of information can engage people who are not predisposed to engaging with engineering and design topics: “Great, now I'm interested in dams now too” (TikTok comment). Another notable comment was from Melbourne Water, the organisation responsible for the water system.

“Thanks for sharing Julian! Thanks to the foresight of our predecessors at MMBW [Melbourne and Metropolitan Board of Works] we have this amazing catchment that still plays a huge part in our water supply 132 years later. It's also no surprise we won Best tasting tap water in Australia from our water supply in Healesville!💧” - Melbourne Water comment on Instagram

Indicative comments relating to the video itself are as follows.

“so cool i love learning new thing about Melbourne love watching you vedios” - Instagram comment

“👍👍👍👍nailed the engineering insights” - Instagram comment

The majority of comments on this video relating to its framing and deliver were positive, although not universally so – with one commenter on this video writing, “Your videos treat people like they're incredibly dumb and stupid. Is your demographic that stupid?” (Instagram comment).

Video creation approach

One of the key parts of any video is the topic and concept, and its worth noting that neither of these locations, or topics were known to the creator prior to this roadshow. It was through this collaboration that these videos, were developed. Some of the mechanisms used in the design this video are as follows:

The ‘hook’ - each of these videos opens with a prompt question or statements which aims to engage the viewer within the first 1 – 2 seconds of the video. As an example, the text, “This fence is why Melbourne water is so good” invokes curiosity for the viewer. “What does a fence have to do water quality?; Is Melbourne water that good? How could a fence make a difference?” Noting that the viewer are neither expecting, or seeking, content on these topics, the idea was to make the idea engaging and accessible.

Accessible - noting that the audience is like new to these topics, ensuring that language used is approachable and accessible. Where terms or features are new, making sure these are explained or show, for example when referencing a location, visually showing a map for clarity.

Fast-paced - noting that the audience has significant choice in their media consumption, ensuring that these videos move quickly and provide a bite-sized introduction into the topic. These platforms (TikTok and Instagram Reels) are short-for by nature and this ensures the video are appropriate for the platform. As McLuhan noted, “the medium is the message” (McLuhan, 1964).

On reflection, the engineering roadshow was a positive and enjoyable experience from a content creation perspective, providing the structure, insights and knowledge to create broadly engaging engineering content.

Conclusions and Next Steps

Additional videos were recorded during the engineering roadshow and are planned on being edited and released over the coming six months. Author 1 has since received a small grant, to develop this project further, including both engagement with the academic community and undertaking a further roadshow project. The engineering roadshow presented a distinct opportunity to use ‘on site’ filming to expand and enhance engineering education materials. While the process does take time, skill and some resources, it was an enjoyable and positive experience to take part in. From a social media and content creation perspective, the themes,

topics and locations that are of relevance and interest in engineering education, can also engage a wider audience through platforms such as TikTok and Instagram and there exists significant potential for collaboration between creators / video professionals and academics. Benefits for the creators are access to academics who can provide insight, access (to sites and facilities) and being on-screen talent. We recommend interested engineering educators to consider the use of on-site video production as a tool and approach as they design online and mixed learning approaches. One final interesting outcome is a closer working relationship between the authors, and greater motivation for teaching. This has led to further opportunities and collaboration.

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