The *Engenius Films* Guide to Film Making

Introduction

Engenius Films are a collection of short films introducing various Engineering topics to children and featuring some real Engineers. The main objective is to show young people the variety, challenge and creativity of Engineering as well as the difference it can make to people's lives – in contrast to the widely held misconception that Engineers 'just fix cars'! The films are aimed at children from Key Stage 2 (older primary school) and Key Stage 3 (younger secondary school) with the intention that they would be used by teachers as lesson starters or just watched individually at home.

The Engineers in the films are from a range of disciplines (Mechanical, Chemical, Biomedical, Manufacturing and Materials Science) and include apprentices, undergraduate students, graduate professionals, post-graduate researchers, post-doc researchers and lecturers. Some had experience of being interviewed on camera but most hadn't. Most individual films had between 1 and 3 Engineers (the formula student film had 6). The films also feature some children from Years 5 and 6 of a local primary school.

I received funding from the Engineering Professors' Council to make the films and something they were particularly keen on was encouraging a legacy so that this collection of films would just be the start of Engineers in companies and universities making their own films to get the message across in their own way, or in the words of Dr. Hugh Hunt, start 'waving their arms around about Engineering' ☺

Types of film

There are different types of filming that can be used as Engineering outreach tools. You could either stick to one form use a combination.

Interview 1: Interview with the interviewer off camera and their questions edited out so that all you see and hear is the interviewee giving complete, stand-alone answers (which make sense without the preceding question). This is a fairly common approach with one camera and one I have used a lot. It is important to film as much 'B-roll' as possible.

Interview 2: Interview with shots alternating between interviewee and interviewer. With one camera, the interview is carried out with the interviewee in shot, then the interviewer is filmed just asking the questions and doing some 'noddies' - this is where you are filmed nodding, smiling and generally looking interested. You can then use a few seconds at a time of noddies in the edit to add interest and cover over where you have edited (just try to match your reaction with what they are saying!). The interviewer's questions can also be edited in at the appropriate place (this means that the interview can be more like a normal conversation and the interviewer doesn't need to give complete stand-alone answers).

Main interview footage

'Noddies' (Interviewer pretends to listen to answers again)

Demo 1: Give a practical demonstration or carry out an experiment while explaining what you are doing (like a cookery show). You would film this with a wide-angle frame to include whatever you are demonstrating and then film close-ups of the experiment, your hands etc. You could also film the whole thing again with a tight shot on your face. Then you could choose between wide and tight shots of you talking and close-ups of what you are handling or referring to making a very interesting piece of video. Be careful choosing your background if you're trying to show a stream of water (in other words, don't do it how I did it here!)

Demo 2: Alternatively, you can film one person explaining a demonstration or experiment to another person who is also in shot and can be asking questions.

Vox-pops: Interview one or two members of the public or school children for their opinions. These are known as 'vox pops' or voice of the people and can work very well to introduce a topic.

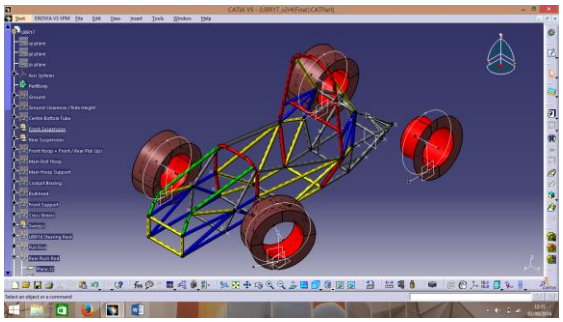
Piece to Camera (PTC): this is where you talk directly into the camera and can work well as an introduction. I used this type of introduction for the following Engenius Films: '*How to design a racing car....', 'Getting to the heart of biomedical engineering', 'Spider Silk' and 'Hydrogen Cars'*. You can either do this standing still or walking toward the camera from a distance away (if you have a wireless microphone).

Voice over (VO): This is one of the easiest ways of making a film and can be very effective. You can film various shots of activity, processes, objects, people etc. and then record a narration over this. You can make an entire film this way or you can use it occasionally as an intro, outro, link or just explanation. For example, I used voice-over as an intro to most of the films, to explain an animation showing how a Hydrogen Fuel Cell worked and over some text to link children's vox pops with an interview with a bioengineer (see the Engenius Films *'Bioengineering: Tissue regeneration'*).

Film a live event: I had the cameraman film me delivering a couple of engineering workshops with a class of Year 6 pupils (one on the physics of flight and one on crashworthiness). For this kind of filming, everyone should just ignore the camera. This could be used within a film about either of those topics or in a film about giving workshops in schools.

B-roll

B-roll is other footage of the interviewee at work, talking to colleagues, using equipment etc. which is used to put over the interview audio to vary what the viewer sees – even just 5min of a 'talking head' can get very boring. As a general rule, you should change what the viewer sees every 6 seconds. B-roll is also very useful to cover over where you have edited their audio (it's difficult to hear a join but easy to see one). You can use video or stills. If using still images, you can add a sense of movement by panning or zooming - you may notice this used a lot in documentaries which use a lot of old photographs or documents.



B-roll examples

As well as filming your own B-roll, you can ask the Engineer featured to send you any video, animations or stills they may have that you could use. You can also use video you find online as long as they have given you specific permission OR it is public domain OR it has a creative commons license that you can work with and you attribute them in the credits (you can find a lot of video with a CC license on Vimeo and photos on Flickr).

How much does it cost?

If this kind of thing didn't take a certain amount of time and money, everyone would be doing it, but how much?

Money

As I mentioned earlier, I received funding from the EPC (around £7000) which covered:

- a professional cameraman (with lighting and sound equipment) for 7 days
- 19 days of my time
- any expenses such as travel, consumables
- some digital advertising

This outlay has yielded 11 films so far, each between 2 and 5 min long, giving a cost per minute of under £170 (the ball-park cost of online short films is £1000 per minute so this is relatively very cheap). However, it doesn't even need to cost that much:

Consumables: these were mainly materials for the workshops I delivered at the primary school and the 'try this at home' experiments I filmed. So these are not essential depending on the kind of film you want to make. I haven't actually used any of the workshop footage yet – they were mainly to give the children a small experience of engineering after being interviewed about it.

Website costs: I just used YouTube (free), Vimeo (£60 for annual Vimeo Plus which has certain benefits but free for normal use) and Facebook which is free with optional advertising costs:

Digital advertising costs: This is actually very cost effective on Facebook. For example, I spent £20 to promote just one film which subsequently had over 700 views. If your organisational website already has a strong social network, you may not need this at all.

Music licenses: You can get a lot of music for free (www.freesound.org). I used some free music and also bought some very inexpensive licenses (only £6 each because my films are internet based and not-for profit) from www.Beatpick.com.

Cameraman fees: This was around £500 per day including VAT, equipment and travel expenses. Although a professional cameraman will give a high picture and sound quality, they do bring a more formal atmosphere to proceedings can make people nervous (I found that it did make some of the participants come across as less relaxed compared with the pilot film I made with my hand-held video camera). The lighting set-up also took quite a long time which makes moving from one place to another a little more difficult. A lower cost alternative could be to work with film or journalism students who had access to a reasonable camera with a separate microphone input (more later) and film in locations with good natural light where possible.

Equipment costs: I bought Adobe Premier Elements video editing software (£80), a Prosound desktop USB microphone (£40) and pop-shield (£8) at my own cost and all have been worth the money. Free editing software is available and most universities have dedicated media editing suites. You can use a normal headset microphone to record voice-over but I would recommend a decent quality microphone as it doesn't cost much and the quality is noticeably better. The camera and lighting equipment were all included in the Cameraman's fees.

Time

All the Engineers who were filmed only needed to give up between 1 and 3 hours of their time. I tried to be as efficient as possible with their time because they are busy people and I wasn't paying them! By far the greatest time expense was editing - this took a lot more of my time than I had anticipated (and budgeted for). As I did this all myself, the pre-production, filming, post-production (editing) and promotion for 10 short films took me around 25 working days over 12 months. But if you're just making one or two films, it shouldn't interfere with your life too much!

Technical considerations

Camera equipment

For good quality sound and vision, you need a decent HD camera with a separate microphone input so that you can clearly pick up what the person is saying without all the ambient sound that is picked up by integral microphones. For this, you need to either obtain a camera with this functionality or employ a professional cameraman who has their own equipment. If your budget doesn't extend to either of these, you can get around it with a standard camera (digital video camera, digital SLR camera with video function or even just your mobile phone) combined with an independent audio recording device which you then add to the video using your editing software. The only other essential is a tripod (there is nothing worse than a shaky camera).

Sound

Assuming you have a separate microphone input, you have several options:

1. Wireless RF lapel mic (lavelier mic). This means the person talking can be standing quite a distance from the camera and can walk around without any loss to sound quality. It requires an RF receiver mounted on the camera and a transmitter (usually in the back pocket) connected to a small lapel mic clipped onto clothing near the neckline. Make sure the lapel mic doesn't brush up against another piece of clothing or jewellery as this will produce unwanted noise. If you are filming outdoors, use a windshield (a fluffy cover). You will need one lapel microphone for each person whose audio you want to pick up.

2. Hand-held microphone. This could be more suitable if two people are talking and you only have one microphone as you can share it. You can either have the microphone in shot like a reporter or hold it lower down and frame it out of shot.

3. Boom microphone (microphone on a pole). This is the method used in films where you don't want to actually see the microphone as it is kept just out of shot. It is also useful if you want to pick up sound from a larger group of people. When used outdoors it will need a wind shield so that it resembles a grey, fluffy rodent ☺

If you don't have a camera with mic input, you need a separate audio recording device. These often come with a lapel mic connection so you record the audio separately, then add to the video in your editing package. Just be careful matching up the video and audio so that they are in-sync. This is how they did it in the old days of cinema and the synchronised the two with the help of the clapper board which you could see on the video and hear on the audio.

Lighting

You can use lighting rigs (my cameraman had 2 tripods with adjustable LED arrays, occasionally with coloured gels) but a lot of film makers just use whatever light is available and adjust the light balance accordingly. One thing to seriously consider is how flattering the light is to the person in front of the camera: Light can either give a youthful glow or it can cast shadows on even the slightest fine line causing a dramatic ageing effect which your subject will not thank you for! As a general rule, diffused natural light or light directed face on are good, artificial down lights are bad.

Location

Ambient sound and acoustics.

This is particularly important if you are doing an interview and is something I got wrong a few times because it hadn't crossed my mind. If you have a lapel mic, you can get away with some ambient sound as long as it is consistent but if the room has a lot of hard reflective surfaces, it doesn't sound so good. You can reduce this by draping blankets and curtains on the walls but easier to find a room with carpets, wallpaper and some soft furnishings. The hall with a kitchen that I chose for doing the demonstrations was very convenient for the experiments and camera angle but very bad for lighting and acoustics. We took about an hour trying to reduce the echo with blankets!

Lighting.

See section above on technical considerations and bear in mind when selecting your location.

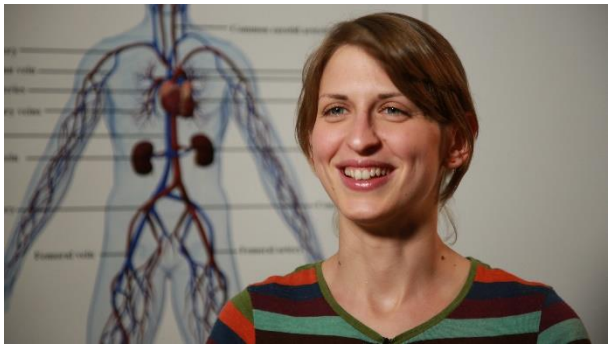
Interruptions

Switch off mobile phones but also let people know you are filming so you are less likely to have someone interrupting you. If possible, put an appropriate sign on the door. Check there isn't going to be some building work going on when you are planning to film (one of my interviews was interrupted by intermittent drilling!).

Background

Think about what is in shot in the background. Check it isn't inappropriate but also try and choose or create a background that is interesting and related to the film topic without being distracting. You can either use something that happens to be there (like the Formula Student car) or if you're using a quiet, empty room for the interview, you can stick up a relevant poster like the one below.

Related equipment or object in the background



Related poster in the background

Filming

Framing

Generally keep the shot quite tight (head and shoulders only), but you can mix in some wider shots for variety, especially if the person is demonstrating something. Also film close-ups of objects or hands carrying out experiments etc. separately and then combine them in the edit (see Spider Silk film where Chris explains how a spider spins silk).

If you are interviewing a person and you are off camera (See 'Types of film: Interview 1'), interviewee should be either slightly to the left or the right of the frame looking towards the centre of the frame. If you are interview more than one person per film you can alternate this for variety.


If you are both going to be on film ('Interview 2'), you can frame the shot so that you can just see just the back of your head, then swap the camera to film the interviewer repeating all the questions (this is where is good to have your questions written down).

If doing a PTC, you can frame the person in the centre or to the side if there is something interesting in the background.

Where to look

This may seem obvious, but I have had to do a lot of re-takes because interviewees have been occasionally looking at the camera which comes across as a bit creepy for the viewer. The interviewer should stand to the side of the camera and the interviewee should look directly at them. It's fine to occasionally break eye contact but better to look down than side to side (which can look shifty). For a PTC, look directly into the camera lens (again, it's OK to look down occasionally but not side to side).

Tell a story

The theme of Engenius Films is a story in itself: lots of people have the wrong idea about what an Engineer is (exclusively male, wearing overalls) and does (fixes stuff) and we want to show them that Engineers do interesting, challenging work that can really make a difference to people's lives. But each film needs to also have its own individual story with a beginning, middle and end. You want to try to draw people in during the first 10 seconds with an interesting question or fact. It is worth thinking about the story in advance – but depending on how well you know the specific topic and person being interviewed (if it's an interview-based film), you may find the story develops as you go and isn't fully formed until editing. It's definitely a good idea to prepare a rough outline story board – it could save you a lot of time when filming and editing.

Keep to the script?

Generally I'd avoid scripting because you want real Engineers being themselves and coming across as naturally as possible on camera. If you are doing a PTC (piece to camera), writing and memorising what you want to say can be a good thing if you can do it naturally but it's not as easy as some presenters make it look! If you're interviewing and you are off-camera, you can write all your questions down and similarly it's a good idea to write a script for voice-over because you take time to work out exactly what you want to say and then just read it while recording with no need to memorise.

Choosing who to put in front of the camera

This section addresses who you should put in front of a camera and how to help them look and come across at their best. The first point is that not everyone thrives in front of a camera. Even people who are extremely confident communicators to an auditorium full of a hundred students or academic peers can be rendered incoherent when faced with a camera lens! They may just need some gentle coaching or you may need to use someone else. The main thing is that they are passionate and knowledgeable

about their subject. Enthusiasm comes across really well on camera and if anything you can go more over the top that you would in a normal conversation.

Language and accent

It's OK to interview Engineers whose first language isn't English (I have featured several in my films) as long as their English (vocabulary, grammar and accent) is good enough to be clearly understood. You can correct some grammatical errors in the edit but this is quite tricky and time-consuming. It's easier to tell them at the time, and let them say it again, especially if they are pronouncing a word in such a way that kids just won't understand what they are saying.

Clothes etc.

Wear bright, bold colours. Very few people look good in black on camera because it creates dark shadows on your face and can be very draining. Thin stripes and small dots aren't great either as they can cause strobe effects. Make-up seems to vanish on camera so you need to wear more than usual to appear the same. Wearing glasses is OK as most lenses now come with anti-glare coatings but I usually give people the option.

Interviewing

This is the easiest way of getting someone with knowledge and passion about Engineering on camera without expecting them to have TV presenting skills. Start with some simple questions to put them at ease. It's also worth starting with questions you won't actually use because people tend to relax after a while a come across a lot better once they are a few questions in. Near the end of one interview (when the interviewee had relaxed and was coming across well), I actually repeated some questions that I had asked at the start when they had been very nervous. You can then re-order answers at the editing stage.

If the interviewer is off-camera and you are going to edit out their questions, the interviewee should answer the questions as complete, stand-alone statements. For example,

Question: "What made you decide to study Engineering?"

Normal answer: "I just thought it looked the most interesting and challenging area to go into." (This makes no sense on its own).

Stand-alone or complete answer: "I chose to study Engineering because it looked like the most interesting and challenging area to go into". This makes sense as a stand-alone soundbite and the interviewer can easily be edited out.

Working with children

I went into a school to interview children and deliver an engineering workshop on camera. We interviewed them in pairs so it was a bit less scary for them. Filming these 'vox pops' interviews was well worth it and gave me some great sound bites to use as introductions to some of the films (see 'What is an engineer?', 'Bioengineering: Tissue Regeneration', 'How to design and build a racing car').

First you obviously need the permission of the Head Teacher if you want to go into a school. As for parental permission to publish video of the children on YouTube etc, some schools have blanket permission forms for their children to feature in educationally related media but you would need to check this with the school and get it in writing that you can use it just in case.

Editing

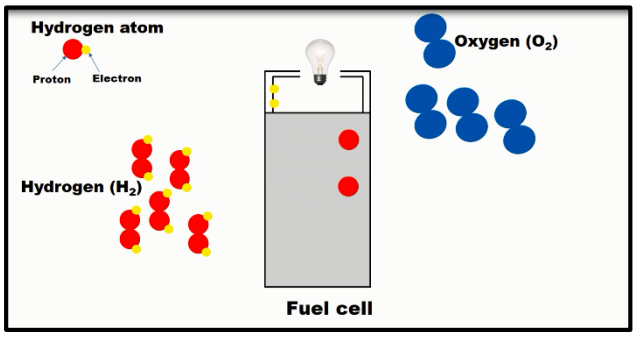
There are loads of different editing packages available. You may decide one of the free products is sufficient but I paid around £80 for Adobe Premier Elements which had all the functionality I needed (plus a lot more that I will probably never use). The main thing is having a package that will allow you to separate video and audio so that you can add section of B-roll video over existing audio (this can be done to add interest or cover over a join as mentioned earlier).

The purpose of editing is to create a film that makes sense from start to finish and doesn't contain unnecessary pauses or repetition and avoiding content that is incorrect, misleading or just boring. Basically, if doesn't add to the story, cut it out. This can be a painful process as you may feel you are having to cut out something that you think is really good but may not be good for that particular film. For these types of engineering-themed films for children, aim for 3 to 5 minutes.

Once you have the main content in a sensible order, you may have to edit individual responses to either shorten them or cut out long pauses. You can then start adding in B-roll, interviewer questions and noddies, close-ups etc to add variety to what the viewer sees and cover over the editing joins.

Extras

You may want to use sound effects, superimposed graphic images or animations and overlayed text to either add interest, humour or enhance an explanation of a scientific concept. You can also create a simple animation on PowerPoint or other software and convert to a format that can be imported into the film.



Animation in Hydrogen Fuel Cell film

Transitions (if it's good enough for Star Wars!)

Most editing software will come with a selection of transitions (e.g fade, sweeping curtains, decreasing circle etc.) which can be useful when changing topics slightly or changing interviewee.

Soundtrack

A musical soundtrack can really improve how a film comes across as long as it isn't distracting: go for instrumental music only if there is spoken audio at the same time and balance it so it isn't too loud. If you are just showing video with text, you can use loud music with lyrics. Just be aware of copyright. You can also use sound effects (free sound effects can be found online or often within an editing package).

Copyright

If you are using any images, video or music that you haven't created yourself, it must be either:

- Public Domain: this has no restrictions - a lot of stuff on Wikipedia is public domain
- Creative Commons license: there are several different types (you would need to look into which one is suitable for you) but it always requires attribution. A lot of CC photographic images are available on Flickr and videos on Vimeo.
- Purchase the right to use it: The music I used was all bought (at a very reasonable £5 per track because of the way I was using it) from www.beatpick.org
- Specific permission from whoever owns the copyright

End credits
This is where you give credit to people who have been involved either professionally or voluntarily in making the film – either on screen or behind the scenes. It's also where you credit any extra video or images you have used. Some sources actually specify how they want you to credit them (if you're not sure, ask).

Getting it online

Once you are happy with your film, get it online. You may want to just put it on your own website, but for a better chance of it being seen by more people, try uploading to YouTube or social media sites like Facebook. If your university has an ITunesU channel, you may be able to put it on there too. I also use Vimeo because you can update the film and keep its location and any statistics associated with it.

Think about what you are going to call it. For example, 'The science of spiders' will probably be more attractive to children than 'A material scientist talks about his research into the mechanical properties of spider silk'. You can also often add search terms to help direct people to your film. If you can, choose or create an appealing thumbnail. This is something I need to work on but apparently it can make a huge difference to the number of views your film will get. Then publicize the films any way you can.

Summary

Films can be a great way of engaging children with a variety of different types of engineering and they can tick some boxes for your next research grant application! They can also be fun to make and will make you to think about what you are doing as an engineer from the perspective of someone who isn't.

Keep it short, keep it interesting and use people who are enthusiastic about what they do.

Useful Websites:

Advice on making films:
www.videomaker.com

Uploading your films:
www.vimeo.com
www.youtube.com

Music and sound effects
www.freesound.org
www.beatpick.com

Extra video and images to use in your film:
www.flickr.com
www.vimeo.com

If you are doing engineering research that you think would make a great TV or radio documentary, contact Academic Ideas Lab who can help you develop it:
www.academicideaslab.co.uk

Written by Dr. Emma Carter
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