Good Laboratory Practice

Julita S. Gasowska

University of Durham

Abstract

Educational videos are very useful tools in HE in general and Chemistry in particular. They can show techniques such as handling a chemical reaction and equipment and at the same time can be very entertaining… or boring. Boring videos are rarely watched and only a very determined person will finish watching them and learn the lesson they are trying to teach. In education there is a need for shorter, more realistic and entertaining movies. You need to grasp the viewers’ attention and keep them engaged.

We decided to use our Undergraduate students to help us to film educational videos and prepare the content of the Advanced Organic Laboratory webpage. Their enthusiasm, down-to-earth approach and experience helped us to prepare content that is more understandable, interesting and approachable for their fellow students.

The project was successful in improving the students’ engagement and in creating new educational tools for the Chemistry Department. It was also fun for the students and staff involved. Students had an opportunity to learn more advanced techniques, deepen their own Chemistry knowledge and feed it back to teachers and their colleagues. Filming, music composing, teaching, presenting, learning Chemistry (theory and techniques) and acting – new ‘stars’ were born.

Introduction

One, if not the, most important set of skills for chemistry students to learn is how to successfully conduct experiments in the laboratory. As Oxendine (1968) and DeMeo (2001) have argued, in order for them to acquire these skills, they need to have clear and well-structured advice and guidance about how to undertake experimental tasks.

Traditionally, such advice and guidance has been given in written form, but since the 1970s video demonstrations have increasingly been used to provide instruction (Kempa 1974; Palma 1975; Pantaleo 1975; Magee 1977; Neerinck 1977; Fine 1977; Lightfoot 1978; Wiegers 1980; Russell 1985; Pickering 1987; Jacobsen 1995; Zimmerman 1996; March 2000; Wulfsberg 2003; Tawfik 2008; Benedict 2012).

However, information and feedback received from Chemistry students at Durham showed that they rarely watched online videos (Chemistry Video Consortium (CVC)) and if they did, they remembered little from them even though the techniques and quality of the performances was high.
The present paper reports on a project designed to discover why students were paying little attention to this medium and to involve them in producing video materials which engaged them and enabled them to acquire experimental skills.

**Why departmental videos were not popular among students?**

From the gathered data and feedback it was found that available videos were too long (between seven to ten minutes, some longer) which made it difficult to pay attention to the whole of the explanation. They were showing equipment that was no longer or never used in departmental teaching labs. Another realisation was that students more often watch videos when they are showing somebody who is their age, somebody that they relate to. It is well known that people prefer to watch somebody using a similar or the same equipment that they can relate to, who have similar experience in the field, and are of comparable age.

Educational videos are easily available and widely used. It is enough to simply visit YouTube and search for educational videos to see a long list of videos, some of them of good quality in both production and content but by no means all.

**How to encourage students to watch recommended educational videos?**

In order to motivate students to watch educational videos and improve their preparation for the labs a change was required. It was decided that the new videos will be made with the involvement and support from students. The aim was to produce shorter clips, with up-to-date equipment and presented by students.

**Casting and role assignments**

Students’ involvement in teaching is becoming more and more popular (Page, 2011). Students are creative, eager/ready to help, have more time to spare for the development of new projects and can easily obtain feedback from their fellow colleagues on the newly created resources.

Third year MChem students were asked to film new educational videos and to prepare the content of the Organic Laboratory webpage. Four students were selected upon a short interview. They had different roles depending on their talents and preferences. There were two main actors, music composer and a camera-person. They were all involved in script writing, preparation of filming location and they were responsible for preparation of apparatus, equipment and chemicals that were required for filming.

**Script writing and music composing**

Each student was provided with a sample of a script for one experimental technique which they had to revise and then use as an example to write the remaining scripts. Students had to research the topic and produce appropriate scripts for the videos. They were encouraged to discuss and help each other and work as a team. One of the students composed four different tunes for the introduction and credentials of the videos.
Filming location and accessories

All the videos were filmed in second and third year organic and inorganic Durham Chemistry Department teaching lab to make it more realistic for students. Everyday teaching equipment was used to illustrate the methods.

Filming

A Sony Handycam (High Definition on Hard Disk Drive (AVCHD) was used for filming videos.

A total of twelve videos was produced within a four week period. Some of these short videos were a part of the same method. For example column chromatography contains three videos: set-up of the column, purification method by column chromatography and cleaning and disposal of the used silica. Every video is approximately two minutes long. Filmed techniques included: extraction, distillation at atmospheric and reduced pressure, drying organic solutions, filtration, recrystallisation, column chromatography, rotary evaporation, drying solids, making fluted filter paper.

The usual time of filming was between one and two days, although some such as rotary evaporation, where the student struggled to remember the content of the instructions, took five days to complete. In the particular case of the rotary evaporation video it was decided to film shorter episodes and put them together using appropriate software after filming was completed. The same method was later used for other videos as this system had worked better and was easier for the students/actors than producing a whole clip in one go. The content of the videos was substantially changed during filming to make it easier and more accessible to students.

During the filming process feedback was requested at various intervals by both students and staff. Comments were made regarding the usability and accessibility of the videos in order to improve the final product. During the filming process an additional focus group was organised to help the project team improve the videos’ content and make it more interesting, logical and comprehensive.

Editing

The movies were ripped from a disc using WinX DVD Ripper from the camera DVD into a computer file, and then converted into AVI video files using Prism Video File Converter so the files could be open with Windows Movie Maker. Both programs are accessible from the Internet free of charge. Windows Movie Maker was used as an editor to assemble the final movies, an easy to use and popular program (figure 1).
Development of the Organic Laboratory website content

Different technique sections were also prepared for the online Organic Laboratory content including: column chromatography, distillation methods, drying organic solutions, extraction methods, filtration, gas chromatography (GC), high performance liquid chromatography (HPLC), infrared spectroscopy (IR), nuclear magnetic resonance spectroscopy (NMR), recrystallisation, and rotary evaporation.

Students helped with the revision of the Organic Laboratory webpage content to make it more approachable and understandable for them and their peers. They decided upon shorter paragraphs, more bullet points and repetitions in the instructions, and more pictures (figure 2).
Figure 2: an example of the redesigned page with instructions

Developing the plate.

Place the prepared TLC plate into a suitably equipped developing beaker. Cover the beaker with the watch glass, and leave it undisturbed. Run until the solvent is about 0.5 cm below the top of the plate.

Figure 5: Developing a TLC plate

Visualizing the spots

If your samples are coloured, mark them before they fade by circling them lightly with a pencil.

Most samples are not coloured and need to be visualized. Spots can be visualized using two basic techniques:

1. Ultraviolet light at 254 nm (shortwave UV). Long wave UV (346 nm) is used, though less often. Hold a UV lamp over the plate and mark any spots you can see lightly with a pencil.

Care! UV light is damaging both to your eyes and to your skin! Make sure you look through the viewing window and do not look directly into the lamp. Protect your skin by wearing gloves.
A number of photographs of the equipment was produced to illustrate the instructions and help students to visualise the content (figure 3 and 4).

**Figure 3: extraction apparatus**

**Figure 4: gravity (hot) filtration apparatus**
Photographs of all the equipment available in the Durham Chemistry Department teaching labs were produced. All the pictures were supplied with the names to help students build up their chemistry vocabulary.

**Conclusions**

The project was successful. Work was finished within the planned timescale. Students enjoyed the experience and the idea of helping to prepare and produce new educational tools for the Chemistry Department.

Students involved in the project had an opportunity to deepen their own chemistry knowledge by helping to improve the already existing sources of information. They had an opportunity to work as researchers and instructors developing their personal and team-working skills.

Produced videos are easy to access and can be repeatedly watched on demand from different devices such as computers, iPods and Smartphones. Videos may be paused at certain points and they may be revisited at a later stage. They prepare students and improve their performance in the same way that books or detailed instructions do but in a shorter time, and are more appealing for those who have problems visualizing the experiments from written instructions. They are easy to understand and absorb. Although it has to be still remembered that educational videos are good for preparation but they cannot substitute real experience and learned skills in a laboratory (Yager, 1969).

Durham University’s Virtual Learning Environment, DUO, offers detailed usage statistics and it was possible for us to evaluate how many students had actually watched the videos. After introducing the new educational videos the number of students who watched them grew from 40% to 65%. It is planned for the next academic year to further publicise them and aim for even higher usage figures.

After introducing the new videos we asked students about how they had affected their work in the lab. Students noted that they felt better prepared and more confident after watching the videos before their lab work. They engaged more often with demonstrators asking about equipment set-up and appropriate techniques to achieve better yields, better quality products and an overall improved experience in the lab.
References


