Producing introductory videos for student preparation for physics practical work

Antonie Fourie, Edward Lee, Izak van der Westhuizen and R E Kroon

Department of Physics, University of the Free State, Bloemfontein, South Africa

FourieA1@ufs.ac.za, KroonRE@ufs.ac.za

Abstract. Experimental work in the physics curriculum is vital to gain practical scientific skills as well as a better understanding of models and measurement. Due to increasing student numbers, limited equipment and laboratory space, students do not have unlimited time to perform experiments during practical sessions. Therefore, students need to be increasingly well prepared in order to complete them successfully. Improved access to the internet has made it feasible to use introductory videos for preparation. The aim was not to reduce or replace written instructions or supervision, but rather to allow students to see the actual equipment and setup as well as measurement techniques in practice and hence allow the students to make better use of limited laboratory time. Producing the videos using professional help had significant time and cost implications, so the challenge was set to produce these internally with filming equipment available in the department. To pilot this project, short introductory videos were produced on four experiments dealing with Lissajous figures, Fourier synthesis, standing waves of a string, and diffraction of light. The demonstrator assigned to each experiment gained experience by acting as the presenter in the video to give an outline of the aim, equipment, method and measurement process. A single experiment took approximately 3 h of preparation and filming time, which was done in short segments of a few sentences at a time. It was useful to have two cameras so that an overview and close-up could be captured simultaneously. With the available filming equipment, the quality video was excellent while the audio quality was merely sufficient. Editing of the videos was done using free software. The running time and resolution were limited to keep the file size to a minimum for easier access on or off campus. Anonymous feedback on the videos was collected from students e.g. initial results showed that only 35% accessed the videos off-campus, while 50% viewed them on campus and 15% not at all. It has been demonstrated that it is possible to create educational videos at low cost and the experience gained will allow improvement of quality and saving of time for future endeavours. A later phase of this project will include assessment whether the videos improve student practical work performance.

1. Introduction

The first semester, second year practical sessions at the University of the Free State consist of a short pre-practical test, the experiment time in which students must complete the experiment and write a log book, and a short post-practical test. The students are given a comprehensive practical manual which they use to prepare for and use during the 3 hour practical session. Students work in pairs and each demonstrator is responsible for four groups at a time. The ideal would be that students have enough time to familiarise themselves with all of the equipment before they start with the practical, then have sufficient time to carefully carry out the experimental procedure while noting everything in their log books and have enough time to interpret the obtained data and draw their own conclusions from that. Unfortunately, there is always time pressure due to large student numbers and limited laboratory time

and equipment. The idea was that introductory videos could help students enter the practical session already more familiar with the experimental setup and procedure, so that they can immediately start with the experiment.

The videos would be to supplement the printed practical manual, not to replace it (as for example the laboratory practical digital video guides of Croker *et al.* [1]) or to replace the actual use of equipment by students (as for example the video-taped instruction assessed by Tamunoiyowuna and James [2] for physics practical instruction of senior secondary students in Port Harcourt, Nigeria). As such, students would still need to study the printed manual thoroughly. For this purpose, the videos would be kept shorter than 5 minutes. In addition, this would also help limit the file size of the video to make it easier to download. It was also decided that filming and editing of the videos were to be done by staff of the physics department. The demonstrators for the candidate practicals were tasked with writing the script for and also to present the video.

2. Method

All of the equipment used was already in the department or was borrowed for making the videos. Two low-end digital SLR cameras on tripods were used (one with a 200 zoom lens), together with an external microphone connected to the main camera and a small aux microphone connected to a cell phone. Trial videos were first recorded to ensure the proper framing of the videos, as well as the image quality and the audio clarity. The built-in microphones of the cameras did not record audio with satisfactory quality, so in the end the audio recorded with the cell phone was used for the videos.

The videos were split into several short scenes because it was easier to present a few lines at a time without a mistake than to record the entire video flawlessly. Having to join a few scenes together, the framing of the shots had to be kept constant for continuity and the position of the cameras were rarely changed. The extra camera with the zoom lens was used to record a specific part of the experiment like an oscilloscope (figure 1) or the diffraction pattern of laser light passing through slits. Filming both at the same time helped keep the framing of the cameras constant and gave the videos continuity. Some editing was done on the videos: the scenes were combined, and the audio tracks were added to the videos with a short title screen. All of the editing was done using the free software iMovie and Lightworks. The videos were loaded onto Blackboard, the university's e-learning platform.

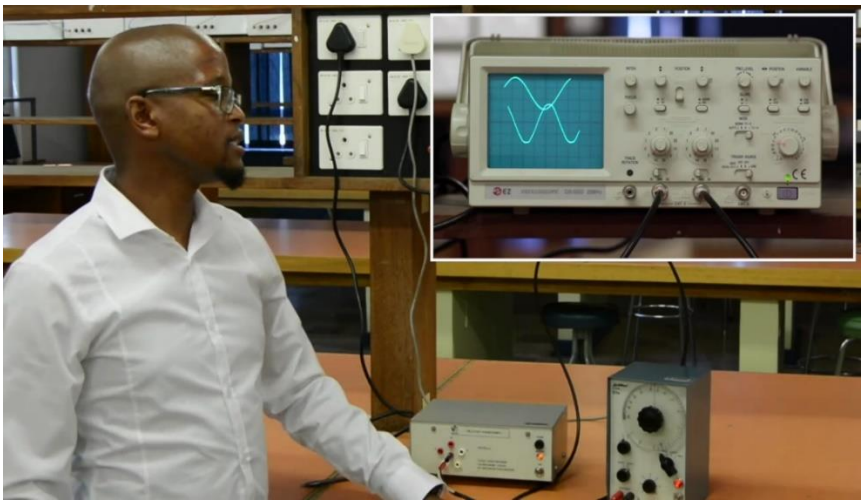
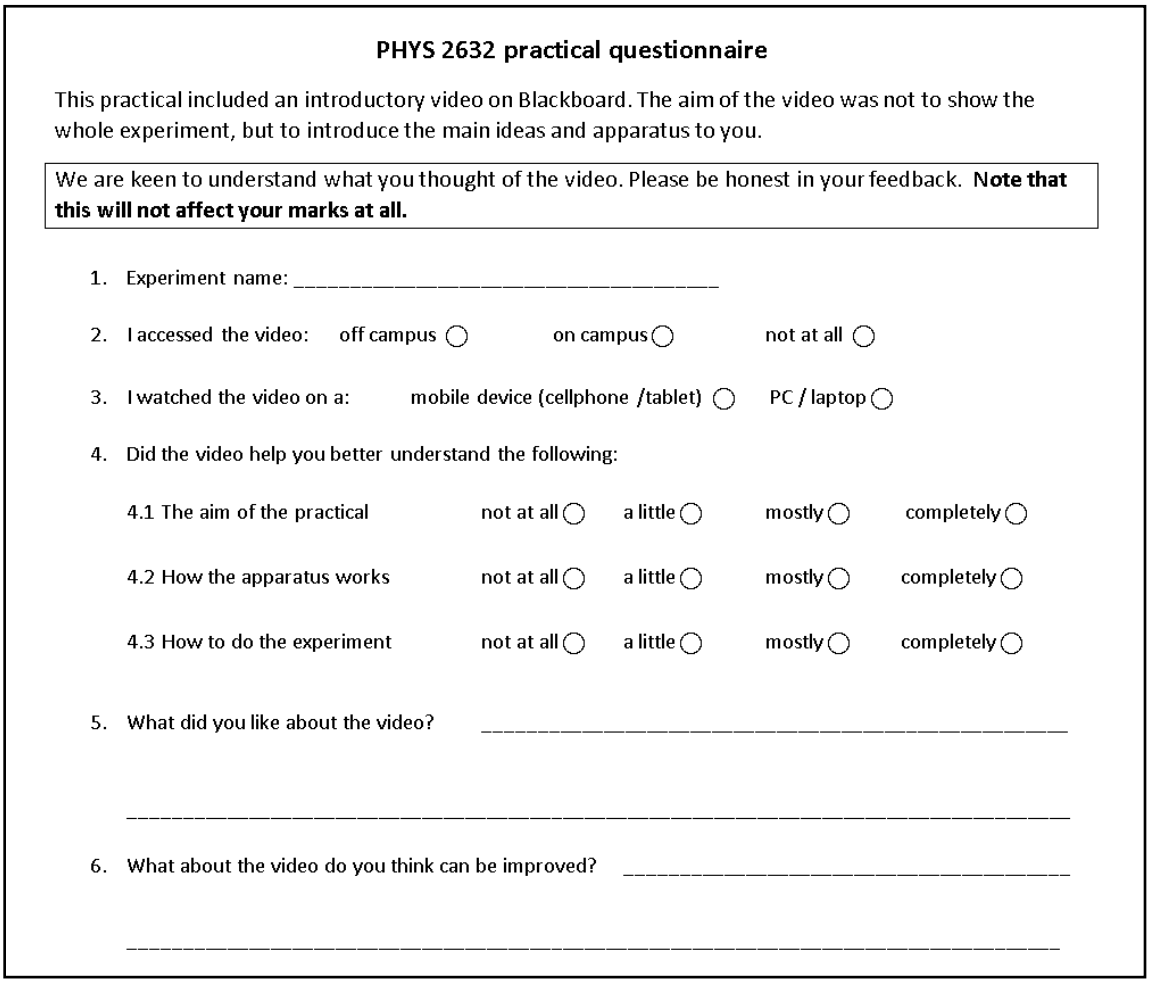


Figure 1. Screenshot illustrating the combination of videos from two cameras.

The format of the videos was as follows: a brief introduction about the experiment, the presenter then showed all the apparatus that would be used and explained how they worked. Some of the experimental procedure was demonstrated so the students could see more or less what the desired outcome should look like. However, it was avoided to give a step-by-step detailed presentation (as for example by Long *et al.* [3]) since the aim was to make the students more familiar and confident with the equipment and setup rather than to illustrate in detail what results they should obtain. Therefore, unlike the videos of physics experiments produced by Pilakouta et al. [4], the videos for this work did not include material from which the experimental results could be obtained.

3. Student feedback

To gauge how effective the videos were, or how beneficial they were to the students, a short questionnaire was set up, shown in figure 2. This was filled in by the students at the end of each of the practical sessions.



PHYS 2632 practical questionnaire

This practical included an introductory video on Blackboard. The aim of the video was not to show the whole experiment, but to introduce the main ideas and apparatus to you.

We are keen to understand what you thought of the video. Please be honest in your feedback. **Note that this will not affect your marks at all.**

1. Experiment name: _____
2. I accessed the video: off campus ◯ on campus ◯ not at all ◯
3. I watched the video on a: mobile device (cellphone /tablet) ◯ PC / laptop ◯
4. Did the video help you better understand the following:
   - 4.1 The aim of the practical: not at all ◯ a little ◯ mostly ◯ completely ◯
   - 4.2 How the apparatus works: not at all ◯ a little ◯ mostly ◯ completely ◯
   - 4.3 How to do the experiment: not at all ◯ a little ◯ mostly ◯ completely ◯
5. What did you like about the video? _____
   _____
6. What about the video do you think can be improved? _____
   _____

Figure 2. The questionnaire filled in by students after their practical.

The feedback from the students was mostly positive: in the comments the students gave compliments or at least had constructive criticism. The videos were not compulsory and a small number of students (11%) chose not to watch them, as shown in figure 3(a). Figure 3(b) shows that most of the students

watched the videos on a computer. About half of the students watched the videos on campus, which is important because it means that most of them did not have additional data costs (Blackboard content is free on campus).

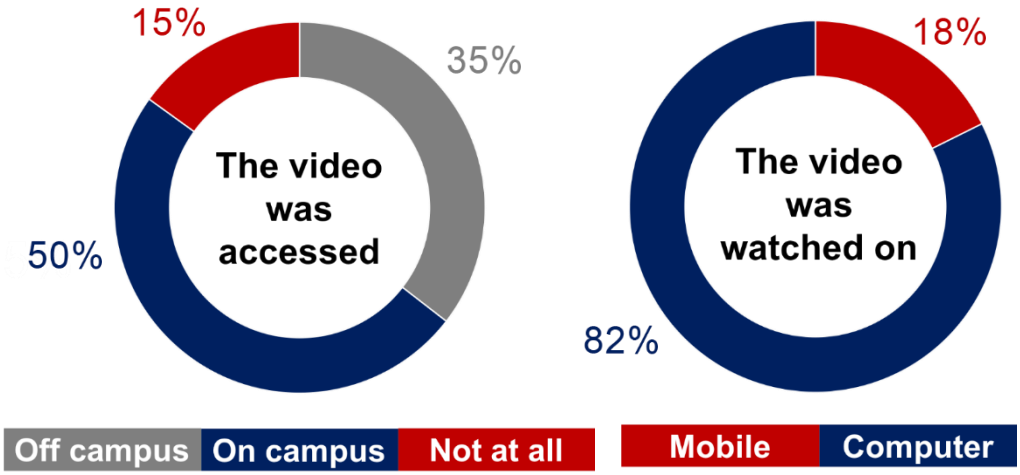


Figure 3. Where and on what type of device students watched the videos.

The majority of students said that the videos helped them better understand the practical, especially how the apparatus works (figure 4). For most students these practicals are the first time they work with a lot of the apparatus and the videos can demonstrate how the apparatus works more effectively than the printed practical manual.

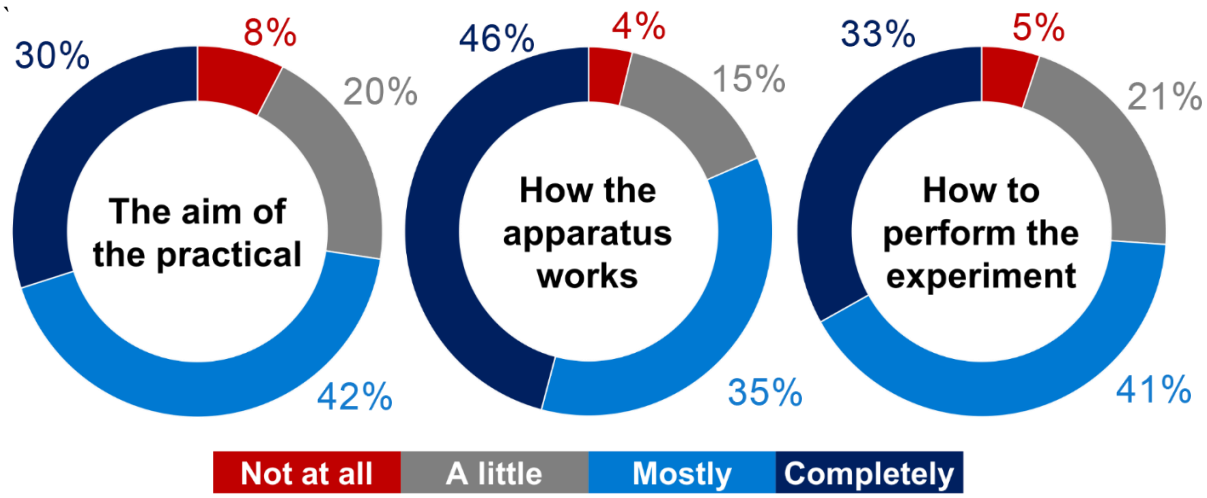


Figure 4. How the students felt the videos helped them understand aspects of the practical better.

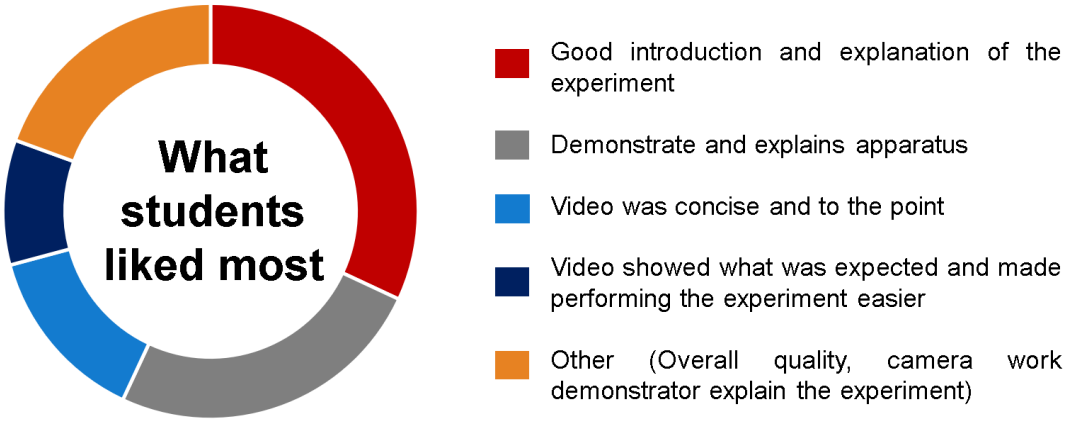


Figure 5. What students liked about the videos.

Figure 5 shows what aspects students identified as positive in the videos. The mixed results showed that many students were happy with the introduction and explanation received, while many others enjoyed the fact that the video explained and demonstrated the apparatus. Fewer students were impressed primarily by the technical aspects of the video or its conciseness. A few students were pleased that the video showed what was expected during the experiment – since only an indication of what was expected was presented, this shows that a good balance between explaining what was expected, without giving the students detailed experimental results to view in the video, was obtained.

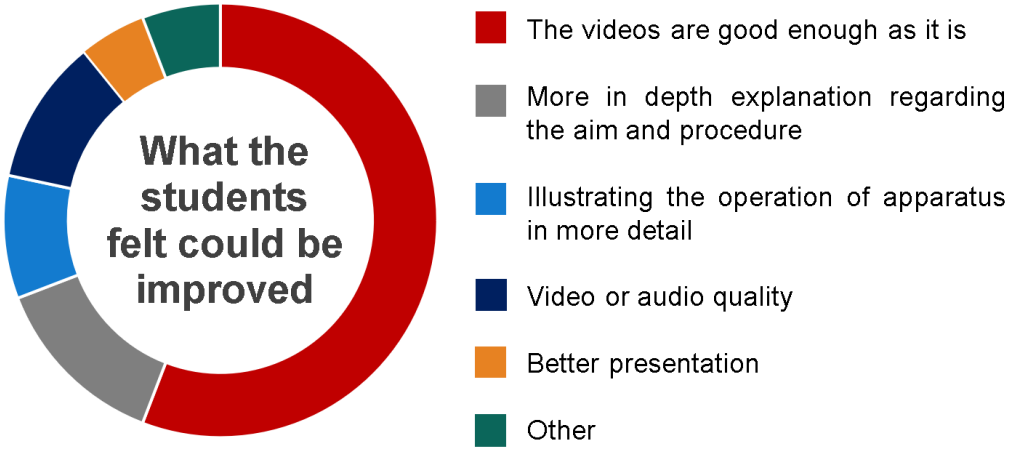


Figure 6. Suggestions made by students to improve the videos.

For the most part the students were happy with the quality and the content of the videos. As can be seen in figure 6, illustrating what students felt could be improved, a few did comment on the quality of the audio, but this was anticipated because a proper microphone for the camera was not available during filming. This is something that would be improved when new versions of the videos are made. Some students wanted the practical to be explained in more detail, but the purpose of the videos was just to be a brief overview of the practical. All the necessary detail can be found in the practical manual, in fact,

quite a number of students commented (figure 5) that they liked that the videos were concise and to the point.

4. Conclusion

All of the comments by the students were very helpful in planning the next phase of the project: to make introductory videos for all of the practicals in the department, from first to third year level. The format of the videos worked well and can be kept the same. The demonstrators will again be responsible for writing the script for the videos and to be the presenter in the video, but they are also going to become involved with the editing of the videos. The only new equipment that will be necessary to procure is a video microphone for the camera. It has been demonstrated that it is possible to create educational videos at low cost and the experience gained will allow improvement of quality and time saving for future practical video production.

References

[1] Croker K, Andersson H, Lush D, Prince R and Gomez S 2010 Enhancing the student experience of laboratory practical through digital video guides *Biosci. Ed.* **16(1)** 1-13

[2] Tamunoiyowuna S, James R 2016 Effect of video-taped instruction on senior secondary students'performance in physics practical in Port-Harcourt Metropolis, Nigeria *Sci. J. Ed.* **4(6)** 169-174

[3] Long J M *et al.* 2014 Video presentations in engineering-physics practicals to increase the efficiency of teaching and learning *25th Annual Conf. of the Australasian Assoc. for Engineering Education (Wellington, New Zealand, 8-10 December 2014)* ed A Bainbridge-Smith *et al*. (Palmerston North, NZ: Australasian Association for Engineering Education) pp 1-9

[4] Pilakouta M, Mitritakis K, Fragkedakis E and Versamis C P 2012 Videos of physics experiments a supplementary education tool for students and teachers *Preprint* 1211.4112 [physics.ed-ph]