# CREATING YOUTUBE VIDEOS THAT ENGAGE STUDENTS AND ENHANCE LEARNING IN STATISTICS AND EXCEL

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*Short video clips can help teach difficult concepts effectively. A series of videos of three to seven minutes each was developed to teach and reinforce elementary but challenging principles in a first year Quantitative Methods for Business course. The response was very positive from students in the course, and from the worldwide audience who viewed the videos on Youtube. This paper describes the rationale for and the benefits for learning from the provision of self-paced short video clips, and the process by which engaging videos can be developed. It reports on the feedback from students and international viewers and gives hints and cautions to aid in the creation of such videos.*

## INTRODUCTION

The subject of statistics is inherently interesting but often perceived to be difficult and inaccessible. Short video clips were developed that are helping to teach statistical concepts, including variation, hypothesis tests and confidence intervals in an accessible and entertaining manner.

## ORIGINS OF THE PROJECT

As is often the case, there is a wide range of prior knowledge among the students in the first year Quantitative Methods for Business course taught at the University of Canterbury (NZ). Many students struggle with mathematical tasks, and are resistant to learning quantitative concepts. There is often also a reluctance to use Excel.

There are certain concepts or skills that many students find difficult, and instructors found themselves repeating very similar explanations many times to individual students. As the course has a strong on-line component, it seemed appropriate to develop a video clip following the steps that the instructors were using to help individual students. A video was developed, with still shots, narration and screen capture and using an imaginary example from business. The video was uploaded onto Youtube so that students could gain easy access to it.

The success of the first video led to a series of videos teaching Excel and statistical concepts. Uploaded to the UCMSCI (University of Canterbury, Management SCIence) Youtube account (www.youtube.com/UCMSCI), these have been well received by students in the class, and thousands of others worldwide.

## MULTIMEDIA INSTRUCTION

There is considerable research regarding the effectiveness of multimedia instruction. Mayer (2003) defines a "multimedia instructional message" as "a presentation consisting of words and pictures that is designed to foster meaningful learning." Mayer shows that "students learn more deeply from a multimedia explanation presented in words and pictures than in words alone", which he calls "the multimedia effect." He develops a framework, based on aspects of cognitive science, which helps to explain this multimedia effect. The framework assumes that humans process pictures and words using different parts of working memory, both of which are limited. However, the total amount of information that can be taken in is increased by using both input channels (pictures and words), which appear to have independent capacities. The framework also suggests that better learning occurs when the learner is actively involved in the process. The integration of the verbal and pictorial models in working memory, along with prior knowledge in long-term memory, requires active cognitive processing, which leads to better retention and transfer (the ability to apply what is learnt in a different situation). In our videos, narration and animation provide information that is processed in two channels, thus increasing the quantity of information that can be taken in at one time.

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Another advantage of narrated video is that of contiguity. Written instructions for using Excel, even those with pictorial examples, have the disadvantage that students must move their attention from the written word to the pictorial examples and back. Mayer's research has shown that contiguity of printed word and image is important to increase learning, in print and in video media. Narration coordinated with the video enables the student to receive the explanation simultaneously with the visual representation or demonstration. There is no shifting of focus between images and words.

The nature of the narration is also important. Mayer's findings, albeit from only one study, suggest that a conversational style of narration – spoken or written - is more effective.

Mayer's work suggests that extraneous material should be avoided, as it can distract from the central message. The editor of our videos was given a free hand for one of the early videos, and it has more distracting images than the others, which may mean that the message is obscured. Nearly all of the videos have humorous asides and puns. It is possible, and needs to be explored, that the humor and subversive asides may distract from the message. Our experience suggests, however, that the humor encourages repeat viewing of the videos, which in itself may encourage better learning. The feedback regarding the humor is all positive. If viewers are distracted by the asides on the first viewing, they can watch the video again.

Another aspect that appears important to learning is that of control. In some discussions on effective teaching, video is perceived as a passive medium, even less interactive than the traditional lecture. However video clips that the student can pause, back-track and repeat, provide a different medium to a video that is delivered to an audience of more than one. This benefit was identified as early as 1980 by Ravindran. The UCMSCI videos are delivered at a fairly fast pace, recognizing that a student who finds a particular part difficult to understand can stop and repeat, whereas it is not possible to speed a video up if it is beginning to drag. Our experience is that students control the speed, sometimes pause the video to perform the same tasks themselves in parallel, and view the video more than once. In this respect the short self-paced video clip has more in common with a session with an individual tutor than with a lecture. The controllable nature of the clip also adds to the student's sense of control over the learning process. Unlike a human tutor, the clip will (and does) repeat endlessly and patiently!

There is a tendency for instructional videos not to use the medium to best advantage, especially when delivering via "talking heads". Though it may be pleasant to view the speaker, the visual or pictorial channel is not being used to increase the effectiveness of the input, and is somewhat redundant. Images in our videos aim to instruct and amuse.

## PHILOSOPHY

The guiding philosophy behind the presentation of the material comes from Cobb and Moore (1997), who emphasized that "*mathematical understanding is not the only kind of understanding.*" I embrace this philosophy, and strive to develop non-mathematical explanations that will lead to sound understanding of the concepts of statistics, particularly those of variability and evidence. Any mathematical expressions were kept to a minimum, and it was assumed that all computation would be performed by the computer.

There is a tendency to protectionism among some statistics instructors, who seem to fear that their tools, if put in the wrong hands, may be put to ill-use. Contrary to that, I believe that we should empower people to use statistics as best they can. In introductory courses, there is no need for them to know how to calculate the standard deviation, for instance, in order to have a feeling for the concept of variation. Similarly the idea of 'evidence' can be used to explain the p-value in a non-mathematical way.

Mathematics is a language that can be used to abstract from a concrete reality in a way that can be applied to other instances. This can help to transfer learning from one instance to another. For students who understand the language of mathematics, the use of a formula can be illuminating. However if we wish to avoid the use of mathematical expressions, or even supplement them, then it is helpful to provide other structures or language in order to help with abstraction and consequent transfer of knowledge to new contexts. In these videos, use is made instead of diagrams and other visual representations (such as personifying the Null and Alternative hypotheses as little stylized characters who want to be picked).

Cobb and Moore (1997) also emphasize that "*data are not just numbers, they are numbers with a context.*" For this reason all concepts were illustrated with concrete examples. Where possible the examples related to the same story, of Helen and the choconutties, and her brother's somewhat dubious assistance. While this is not as powerful as real data in some respects, it provided continuity and humor, and was intended to make the videos more memorable. Helen is not a statistician, but an anime character, which may also help to make the use of statistics more accessible to the viewers.

## WHY USE VIDEO

Seal and Przasnyski (2003) reported on their use of technology to support the teaching of Operations Research which, like statistics, is a mathematically-based decision science. They "created short videos of instructors explaining difficult concepts or solving homework problems." They found, as did we, that storyboarding and scripting were useful and instructive. Similarly they found that screen-capture movies are useful for software demonstrations. They developed a complete MBA-level course, using a high level of technology. They were reluctant to conclude that the students learnt any more, but "believe that using technology has tremendous potential for improving teaching even though it takes time and effort to do it well."

Similarly, it is not possible at this stage to isolate the contribution the controllable short video clips made to learning. They are a small but popular component of our Quantitative Methods for Business course, which provides much varied learning support, in the form of on-line quizzes, tutorials, lectures and video of lectures, on-line notes and lessons and a modular Personalised Self-paced Instruction format.

## STUDENTS' AND ON-LINE RESPONSE

In the teaching reviews for the lecturer there were several unsolicited comments about the videos. "The Youtube videos are without a doubt brilliant." "The Youtube videos were different and worked as a different type of learning tool, helping understanding", "Youtube videos useful".

Students were asked for feedback after the course regarding how the videos helped their learning. Responses included:

"Having the examples of Excel, where we could see you putting the spreadsheet together as you talked was very helpful, rather than a print out which just shows the final result." "I could watch them at home and they made the learning easy."

They were also asked how they watched them, and they responded that they paused them and repeated parts. The humor did not appear to them to be distracting. "Good features were the story telling of the subject as opposed to teaching the topic on its own and step by step." They also liked the Helen and the choconutties story that ran through many of the videos.

Youtube is a community site, where people can leave comments. The most popular of our videos is "Understanding the p-value", which was viewed over 15,000 times in fifteen months, and in September 2009 was listed on the first page of a Google Search on "p-value". It was rated at nearly 5 stars out of 5, and had instructors using it in class, as well as referring to it in on-line material. From the comments, the humor and entertainment value seems to be the defining difference from most other videos used for teaching Excel and similar material.

## DEVELOPING A VIDEO

Over the course of a year we developed ten videos and refined the process by which they are made. The first step is to define a small set of knowledge or skills that can be delivered within the time frame. If the material is taking too much time, it is better to make an additional video, rather than risk losing the viewer's interest. The instructor's experience of explaining the concept is drawn on to work out a script, including a concrete example. As the script is to be delivered word-for-word, it is important to read it aloud, to make sure that it flows. The use of a "storyboard", common in the film industry, is invaluable here also. In a storyboard the script is broken up into small segments, and either a picture or description is placed alongside it. This helps the developer to identify useful images and video to accompany the narrative, and provides information for the editor.

We recorded the narration first, then added video and images to it. This was found to be simpler than attempting to narrate while doing screen-capture video, and gives a better result. Free sound-editing software, Audacity, is very useful for removing verbal slips and corrections and false starts so that the narrative flows. For the early videos we used Microsoft Movie-maker for editing, but later progressed to Adobe Premiere. Animations were developed on Flash, and screen-shots were copied to Corel-Photopaint and edited for inclusion. Moving demonstrations of procedures on Excel were captured using another freeware package, Autoscreen. These were speeded up or slowed down to fit the narrative.

The Youtube website itself provides extensive feedback on what maintains interest in the viewer. From this we observed that attention dropped sharply at the start of a summary. Consequently we stopped including summaries. Similarly we avoided any introductory overview. As the videos are viewed repeatedly, this can be tedious and is unnecessary.

## OTHER BENEFITS

A short video clip provides the developers with a useful discipline of thinking clearly about what to say. In a 50 minute lecture, one can be more relaxed and try several attempts to get an idea across. The time (and attention) limit inherent in the short video clip provides a focussing element. This has in turn improved the explanations given in class. You have to think very hard about the pedagogical aspects of the material–what is it that makes it difficult to grasp, and what are some ways to make it clearer. A useful homework assignment for students at a higher level might be to develop a video, or a script and storyboard for one.

## MARKETING STATISTICS

Wild (1994), after examining columns and commentaries that lament the negative image of statistics in the wider community, comments that "In marketing, we need all the help we can get." Few would argue that the popular perception of the discipline of statistics is that it is boring, difficult and inaccessible. The majority of videos on Youtube with respect to statistics do little to remove this perception. In creating more entertaining and engaging videos, we hope that we can contribute to improving the popular face of statistics.

## OPEN SOURCE TEXTS

The internet allows many people to gain access to information that they might not have otherwise. Statistical understanding is important to dealing critically with the information provided. It seems fitting that people all over the world can use these videos to learn about statistics. Seal and Przasnyski (2003) encouraged the exchange and sharing of teaching materials via the Web, for the benefit of students and instructors.

## CONCLUSION

The development of short self-paced video clips explaining difficult concepts in statistics and Excel has proved to be a worthwhile addition to the instructors' toolkit. The use of elements of multimedia instruction seem to help people learn better. The instructor also gains understanding, and statistics is getting a more friendly face, all over the world, thanks to Helen and her Choconutties.

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