EFFECTIVE VIDEO-BASED RESOURCES FOR LEARNING STATISTICS

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Over the past few years, I and various colleagues have been involved in producing, using and evaluating various video-based packages for teaching and learning topics in mathematics and statistics. We start by identifying an area of student difficulty and then proceed to develop teaching and learning materials, and trial and evaluate them. Our most recent package is a video and associated print materials entitled Statistics for Quality - Using Statistics in Australian Industry. During trialing and evaluating this video, we have obtained information about students' and teachers' attitudes to statistics. We have also investigated their views on what makes a video an effective teaching and learning tool.

BACKGROUND

Appropriate materials, in print and other media, are a very important component in successful management of teaching and learning. The availability of such resources allows for an individualised, flexible and self-paced approach to teaching and learning. Unlike some areas, statistics has not traditionally had a large range of video resources, although this situation is changing. One excellent resource is the *Against All Odds* series of 26 videos, developed in 1989 by COMAP. A more recent series of eight videos is the Open University's *Elements of Statistics*, first broadcast on British television in 1995. Inspired by watching a preview of the *Against All Odds* series (at ICOTS3 in Dunedin), Leigh Wood and I determined to start preparing some video-based resources for learning mathematics and statistics. Working also with Dubravka Petocz, David Griffiths and Peter Wright, together with many people on the scripting and filming side, we have to date prepared five video-based teaching packages. They are:

- *Off On A Tangent - The Concepts of Calculus* (1992), [LW, PP, DP]
- *Count Me In - Combinatorics: The Art of Counting* (1993), [PP, LW, DP]
- *Pattern and Proof - The Art of Mathematical Thinking* (1994), [PP, DP]
- *The F-Files - Functions as Models of Reality* (1995), [LW, PP]
- *Statistics for Quality - Using Statistics in Australian Industry* (1996), [PP, DG, PW]

The first four videos were made by the Open Training and Education Network, the last by Summer Hill Films. The funding for some of the projects has come from CAUT, the (Australian government) Committee for the Advancement of University Teaching.

This paper focuses on the last of these, *Statistics for Quality - Using Statistics in Australian Industry*, a video showing five case studies of statistics used to monitor and maintain quality in a variety of Australian service industries. The video is designed to help overcome negative perceptions of statistics by showing students how straightforward statistical concepts are used in a very practical way by people in industry to make sure that their products and services reach high quality standards. The five case studies are:

- Rosemount Estate, a winery in the Hunter Valley, focusing on the bottling process
- AGB McNair, an opinion polling company, showing an exit poll from a state election
- Dow Corning, a chemical engineering company, producing construction sealants
- New South Wales Board of Studies, marking school matriculation examinations
- BHP Refractories, making bricks for lining blast furnaces in steel production

The video package includes a booklet with a range of exercises and activities for student use. These include 'cloze' passages for language practice, statistical questions for group discussion, writing or presentation, as well as some more traditional statistical exercises. In the process of trialing and evaluating this video, Rod Freedman of Summer Hill Films and I interviewed several groups of students and teachers, showing them segments of the video and asking them about their perception of statistics, their feelings about what makes a good educational video and their reactions to *Statistics for Quality*.

THE ROLE OF VIDEO IN STATISTICS TEACHING

Before I report on the results of our testing, I will outline current knowledge about educational video. A useful summary of the place of video in statistics teaching, and its historical development, is given by Moore (1993), who has been particularly involved in developing the *Against All Odds* series. The Open University experience with videos was discussed by Lunn and Javorski (1994) at ICOTS4 in Marrakech. These authors discuss the strengths and weaknesses of video as a means of instruction. They point out that video is particularly good at bringing reality into the classroom and at showing the visual details of a process using graphics. Video communicates with students on an affective plane to change their feelings about a subject and present role models (think of the powerful effects of TV advertising). It is also good at providing a setting for development of

higher-order skills. On the other hand, video is unsuited to being the sole mode of instruction as it is not interactive, it does not allow students to take coherent, sequential notes on a topic, and it is not good at presenting the details of typical textbook examples. All this implies that video is best used in small doses as part of a system (including texts, study guides, computers, telephones, e-mail, tutorials, multimedia, etc) that provides significant variety for learners. In such a way, it promotes the deep learning that is characteristic of the most successful learners. Ramsden (1992) discusses the background to various styles of learning and suggests principles that promote successful learning. Gal *et al* (1994, 1997) point out the key role played by the affective domain in learning and discuss current research on students' attitudes towards statistics. Video then does not have a didactic role, and it does not replace the teacher, lecturer or textbook at exposition, examples and details. Rather, it is used to change attitudes, motivate, show role models and vary the pace of learning. It is best used to introduce and motivate a topic, to start a discussion, to present a situation for analysis, to introduce a simulation or to summarise a topic. It can also be used in the development of multimedia, an interactive combination that can use the strengths of each of its components and avoid their weaknesses. Small segments of video can play an important role in a multimedia package.

THE INTERVIEWS

Interviews were carried out with the following groups of people:

- *Initial focus groups to test the case study concept* (a Technical and Further Education mathematics class of 9 students [TAFE], a meeting of 30 mathematics secondary school head teachers [HT], a first-year university statistics class of 20 students [ST1])
- *Discussion groups to trial the edited segments* (a university statistics bridging course of 12 students [BR], an occupation health and safety course of 20 students [OHS], a first-year university statistics class of 18 students [ST2], a high school mathematics class of 22 girls [GHS], an English language class of 15 overseas students preparing for higher degrees [ESL], a third-year quality methods class of 35 students [QM])

The initial focus groups were shown a rough cut of the *Statistics for Quality* segment on examination marking, together with part of the first video in the *Against All*

Odds series and an excerpt from our own calculus video, *Off On A Tangent*. The discussion groups were shown a penultimate edit of two or more of the segments of *Statistics for Quality*. Many of the technical comments from the interviews were incorporated into the final version of the video and made an important contribution to the final product. They included suggestions to balance statistical information and information about the case study, to include point summaries at the end of each case study, and to put in more repetition of basic ideas. Our experience with this shows the crucial importance of testing and trialing. Generally, teachers and students concurred in their impressions. However, there was one interesting disagreement. The mathematics teachers felt that the *Against All Odds* excerpt was too frenetic and would not appeal to students. *'It's too much. Stats, stats, stats all the time … too much of a hammer. Kids would be turned off.'* [HT] Yet the video-clip pace and style evoked a more positive response from the students. *'It keeps you interested in it, keeps flashing things at you, keeps changing, keeps your attention.'* [ST1] This is important, because it is usually the teachers who select the material, and they could censor some materials that appeal most strongly to students.

ATTITUDES TOWARDS STATISTICS

Some of the comments showed us that statistics does have an image problem. In answer to questions about why they are studying statistics, what they think of statistics and whether they would like to work with statistics, this is what some students replied.

'We don't get a choice. I didn't realise we'd do stats as part of a maths degree.' [ST1]

'I don't like stats much, but we have to do it. It's just another course in maths.' [TAFE]

'I wouldn't want a career in statistics. It bores me. I wouldn't mind testing different things, but not the same thing over and over.' [GHS]

'Statistics seemed to be something strange and useless. I was studying engineering, and I didn't know why I had to study statistics.' [ESL]

Many students identified teaching as a problem with the subject.

'I think it's got to do with the way it's fed to you. If it's put in a practical way it's of interest to you.' [ST1]

'Stats is used throughout life, but the way it's taught is just not very relevant.' [TAFE]

'It has to be made real. You need to relate to it in your own life as something you're going to use, instead of just learning it for an exam.' [TAFE]

But problems of image are not confined to students.

'I find it hard to enthuse my staff, because they're scared to teach statistics.' [HT]

Not all reactions to statistics were negative.

'It's so commonly used in science. That's why I'm interested in it, because everything is based around stats.' [TAFE]

'I look at stats as the most realistic part of mathematics.' [ST2]

In particular, comments from students who had experience of working were different.

'If you work at a fast-food chain - I work at KFC - you can see the stats of the customers, and you can presume how many are going to come in that day.' [GHS]

'I'm studying stats because I want to do it. I'm in a different position - I work. When these people go to work they'll find out everything they do they'll need stats. I think it's really relevant.' [ST2]

'I think stats in the form of numbers is important, because it's the sort of language that management understands. They bring everything down to numbers, so we've got to be able to do that too.' [OHS]

REACTIONS TO VIDEO SEGMENTS

Completed segments were felt to be very relevant, especially but not only by students with experience in the workforce.

'It helps us to understand how statistics and wine are related, how stats are used - they must be used in just about everything!' [GHS]

'I think it gives a clear impression that stats is important, that you can use the stats of quality in any field - elections or manufacturing or marketing.' [ESL]

Students liked the basic level of statistics shown and used.

'The statistical information given was pretty basic. None the less, it was a very good way of putting it across.' [OHS]

'I guess it just makes you realise that stats isn't as hard as you think it is at the beginning, that it can be put in simple ways and doesn't have to be complicated.' [ST2]

'I don't think management wants complicated stats. They want it simple and basic, and they want to know how it applies to them.' [OHS]

The graphical features attracted positive comment.

'The graphs were very dynamic. It was like a picture worth a thousand words, basically the complete story.' [OHS]

The segments provoked thoughtful comments about the statistics shown.

'Why do they reject the batch when 3 corks are off? How do they know it's the right number?' [ST2]

'There should be more than one person doing the rating and maybe sum up the scores, because one person can be too subjective.' [OHS]

'I'd be curious as to how they got those benchmarks that they set for their standards. And are they the only tests that they do? There must be a stack of others.' [OHS]

'It didn't say much about the selection of the sample, just that it was random. But was it one a day, or were they taken at even times during the day's production?' [QM]

'It's interesting that they can't accept the existing standards. I wanted to know what the Australian standard for corks is, and why it wasn't acceptable.' [BR]

A summary of the video from one student:.

'Overall, it got the message across that, yes, statistics is useful in a practical situation in a range of industries.' [OHS]

And one final comment from a teacher.

'There's two things I want from video: the real-life applications and the animated demonstrations. The maths we can do on the blackboard.' [HT]

SUMMARY

Interviews were carried out with several groups of users during the development of this video package. Their comments give a useful insight into attitudes towards statistics, and views of what makes a video an effective learning tool. Students and teachers are generally in agreement that real-life examples help to show the relevance of a study of statistics, to stimulate interest in statistical ideas and to increase positive attitudes towards the subject. They agree that the visual power of video can be used, especially through graphics and animation, to communicate difficult statistical concepts. Our experience highlights the importance of trialing and evaluating learning materials, and the benefits to teachers in being involved in this process.

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