Teaching 'How science works' by making and sharing videos

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ABSTRACT *Science.tv* is a website where teachers and pupils can find quality video clips on a variety of scientific topics. It enables pupils to share research ideas and adds a dynamic new dimension to practical work. It has the potential to become an innovative way of incorporating 'How science works' into secondary science curricula by encouraging collaboration and discussion between schools. In this sense, it is a virtual 'science conference' for participating schools. This article suggests how this might be done and invites interested teachers to become involved with the project.

Science.tv is a powerful new resource for science education that is being developed by independent film-maker, Matt Thurling. It is a website where teachers and pupils can find quality video clips on a variety of scientific topics. Unlike other file-sharing sites (such as *YouTube*), its content is restricted to science topics that are relevant to schools, so *Science.tv* can be recommended for use in schools without concerns about accessing inappropriate material. These features are well worth investigating and using, but are only part of the potential value of the site. *Science.tv* has the potential to become an innovative way of incorporating 'How science works' (HSW) into key stage 3 (ages 11–14) and 4 (ages 14–16) science curricula. Below I give an example of how this might be done.

The aims of HSW are ambitious. The revised National Curriculum for England (QCA, 2008), says:

How science works is more than just scientific enquiry. It provides a wonderful opportunity for pupils to develop as critical and creative thinkers and to become flexible problem-solvers.

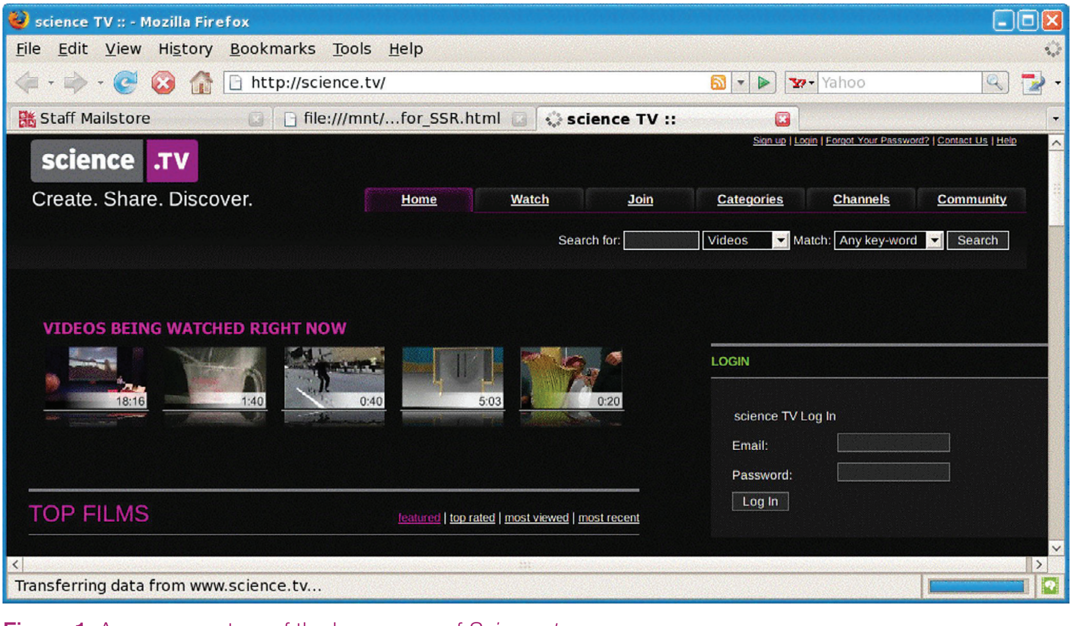

Figure 1 A screen capture of the homepage of *Science.tv*

A sense of excitement communicated in national documents is unusual and merits closer attention because it reflects an officially recognised aim of making science education at key stage 3 more exciting and engaging by '*creat[ing] a flexible curriculum that is both personalised and makes use of local contexts*'.

The National Curriculum for Science emphasises the importance of 'communication' by making it a separate strand of HSW:

use appropriate methods, including ICT, to communicate scientific information and contribute to presentations and discussions about scientific issues.

The notes for guidance stress the importance of ICT and media technology in achieving these aims:

Use appropriate methods, including ICT, to communicate scientific information: for example, digital photography, video or podcasting as alternatives to text-based approaches.

Media technology equips pupils with tools that empower them to communicate scientific ideas creatively. Their videos and podcasts can be uploaded to the Internet and shared with other schools. Additional information such as data, graphs and charts can be posted along with the videos in supporting documentation. The materials can be accessed by teachers and pupils in other schools. Online discussions can take place between schools on *Science.tv*, allowing the material to be discussed and evaluated.

Professional scientists communicate their findings in written scientific papers, but also in the form of conference presentations and posters. This allows effective debate with their scientific peer group and is a major way in which ideas can be evaluated in science. *Science.tv* gives us the potential to create a powerful analogy to the scientific 'peer-review' process by which scientific papers are validated.

An example investigation

Do computer games players have better hand–eye coordination than non-games players?

Ingram and Thurling have used *Science.tv* to host a video (see *Websites*) made with a year 10 (age 14–15) science class, which was learning the process of 'How science works'. The video is a report of an experiment to test whether computer games players have better hand–eye coordination than non-games players.

The strategy for planning the investigation followed the development cycle originally outlined by the Assessment of Performance Unit (1984), which was subsequently adopted as a model for practical science (Sc1) in the original National Curriculum for Science (1989). Various iterations of the model have appeared in numerous GCSE and A-level specifications for the sciences and for psychology. Figure 2 shows a flow chart of the development of the process and the inputs needed at each stage of the planning.

The idea for the problem to be investigated arose from discussion with the class, which came up with the initial concept of asking whether playing computer games was 'bad' for people. Their consensus was that computer games 'had to be bad' because that was the popular perception. Interestingly, some members of the class doubted whether this would a suitable topic for an investigation because it was not 'scientific enough'. The discussion was moved forward by asking the class to survey the extent of computer game playing activity in their year group and also to do an Internet search of the possible benefits of computer games. This revealed an article on *Medical News Today* (2007), outlining a US study suggesting that surgeons who play video games have better keyhole surgery skills than those who do not. The article suggested that this effect was due to 'hand–eye' coordination.

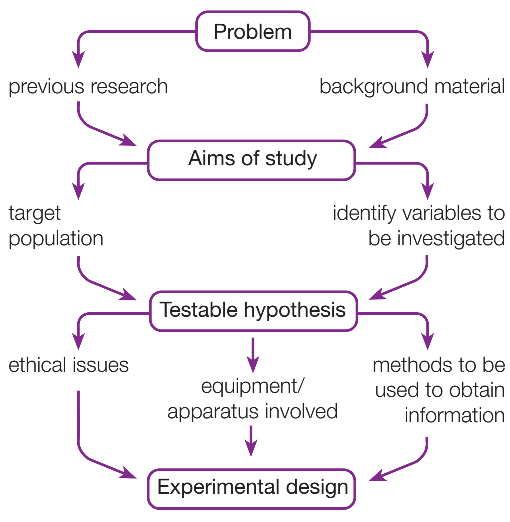

Figure 2 A flowchart of the development of the investigation

It became clear, then, that the investigation would focus on assessing hand–eye coordination, although the pupils had little idea how this might be done. The teacher provided input at this stage, by enabling pupils to assess their own hand–eye coordination using a mirror-drawing technique. This practical appeared in the Nuffield A-level biology materials (1985: 50), although its genesis probably goes back further. The apparatus is set up as shown in Figure 3a.

Participants were asked to look into the mirror and trace a pencil line between the inner and outer lines of the star (Figure 3b). Looking at the mirror reflection of the star disturbs the normal hand–eye coordination, and forces the brain to learn to adapt to the new situation. The time taken to complete the tracing of the star and the number of times the pencil line crosses the innermost or outermost line are correlated with the ability of the brain to adapt to the unfamiliar situation. It is this 'adaptability' that might be influenced by playing computer games.

The class felt that this was a technique that could be used in their investigation and then started to discuss how they might measure the effects of playing computer games. Complex designs started to appear, involving participants carrying out mirror tests before and after playing computer games. Although such 'repeated measures' designs are feasible, they require a considerable amount of planning and preparation. Eventually a pupil remembered the class survey she had carried out. This survey revealed that quite a number of pupils never played computer games. She suggested we record whether the participant did or did not play computer games alongside the results for the mirror-drawing experiment. The class measured the time taken to complete the tracing of the star and the number of 'mistakes' made when the pencil line crossed the edges of the star.

The target population was defined by those pupils who were being taught in the adjacent classrooms when the data were being collected. A total of 40 participants volunteered for the study.

As part of the planning phase, the class was encouraged to think about the ethics of dealing with human participants. All participants had to give informed consent and had the right to withdraw themselves (and their results) from the study at any time. The participants were not videoed carrying out the experiment. The class wrote a set of standardised instructions that was read to each participant before the data were collected and a standardised debrief that was read afterwards.

The results of the study showed that, on average, the computer games players were quicker and made fewer mistakes than the non-games players. The class wrote this up as a study and a version is published on *Science.tv*.

The video was made after the experiment had been completed. The class worked with Thurling to help storyboard and script the video. Those who wanted to be were involved in the video-making process.

Sharing the research

The video sets out to present the outcome of the experiment in an entertaining and visual way. It is

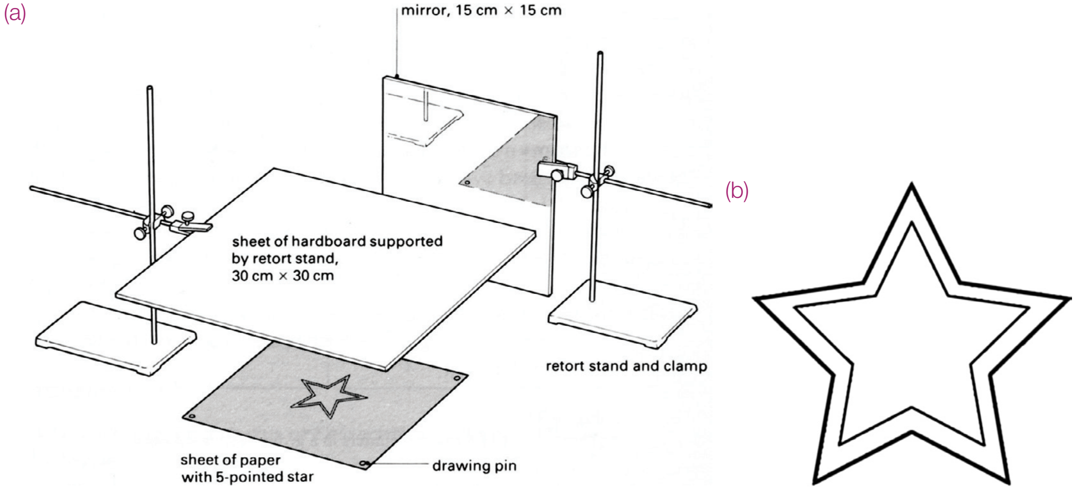

Figure 3 Using mirror drawing to test hand–eye co-ordination (from Nuffield A-level Biology, 1985)

supported by a background paper (see *Websites*), which presents methods, results and conclusions of the experiment. On first inspection, it seems as if computer games players do have better hand–eye coordination than non-games players. The report also considers the reliability of the data and the validity of the conclusions is discussed alongside contemporary scientific research.

The author and the pupils invite other schools to repeat this experiment or carry out further studies of their own to explore this research idea further. To what extent are their conclusions from this experiment repeatable? Can the conclusions be generalised widely, or do they depend upon the test being carried out? Does the amount or type of computer game played affect the results? This is a research area that could be developed by further experimentation and has a high level of interest and appeal to pupils. It is, therefore, a very suitable context for developing the skills of 'How science works'.

Using video technology

The use of video technology has become almost commonplace in schools and it is becoming a natural medium of communication for young people (as evidenced by the immense popularity of *YouTube* and the use of video on social networking sites). Pupils seem to enjoy the process of video making once they have got over their initial shyness.

I have worked with groups of year 10 pupils making short videos on Shakespeare as part of an annual residential course at Clifton College. Pupils seem to grasp the essentials of video making once they have been shown the basic techniques. These are: story-boarding, composing camera shots, lighting, editing, uploading finished clips. Video making has the potential to become resource intensive and time consuming. For these reasons, we restrict the length of the videos we make to one minute. We recommend the use of powerful computers (Macs or PCs both have perfectly adequate video-editing software), with plenty of RAM memory and hard-disk space. A one-minute film, including all its source materials, can occupy several GB of hard disk space.

Video cameras have recently begun to turn to solid-state memory (cards) or hard drives for storing footage, rather than tapes. Check your camera: newer cameras will use USB cables to transfer footage; tape-based cameras will need a firewire connection between the camera and the computer. Microsoft *Movie Maker* and Adobe *Premiere Elements* are entry-level video-editing software that are intuitive to use and are more than adequate for producing short video films. It is important to check that the latest version of Adobe *Premiere Elements* can run on the available computers.

Most schools have policies about obtaining informed consent from persons featured in video clips and it is important that these policies are adhered to, especially if the pupils are under the age of 16. It may be necessary to obtain permission to film in certain locations if they are off-site. There are copyright implications for using third-party sounds and images.

The discipline of having to communicate a complex message in one minute is challenging, but worthwhile. The video clip associated with this article is one minute long; abstract ideas (such as the reliability and validity of the results) seem to be easier to develop in the supporting documentation that accompanies the video. In this respect, the video and supporting documentation are directly analogous to conference presentations and published papers. This corresponds to the '*use of appropriate methods ... to communicate scientific information and contribute to presentations and discussions about scientific issues*' in the National Curriculum.

Conclusion

Science.tv is has the potential to encourage collaboration and discussion between schools. Pupils can comment directly on the videos seen, whilst sharing videos of their own ideas. In this sense, *Science.tv* is a virtual 'science conference' for participating schools. Sharing research ideas between schools adds a dynamic new dimension to practical work, and encourages the effective communication of information and ideas, which is integral to 'How science works'.

Science.tv is a project in its infancy and teachers who are interested in these ideas are encouraged to contact its developer, Matt Thurling, directly at mt@science.tv.

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Websites

The video: www.science.tv/schools/video-workshops.html

Background paper: www.science.tv/schools/learning-resources.html

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