Assessing the impact of online academic videos

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The web provides scholars with mechanisms to publish new types of outputs, including videos. Little is known about which scholarly videos are successful, however, and whether their impact can be measured to give appropriate credit to their creators. This article examines online academic videos to discover which types are popular and whether view counts could be used to judge their value. The study uses a content analysis of YouTube videos tweeted by academics: one random sample and one popular sample. The results show that the most popular videos produced by identifiable academics are those aimed at a general audience and which are edited rather than a simple format. It seems that the audience for typical academic videos is so small that video production in most cases cannot be justified in terms of viewer numbers alone. For the typical scholar, videos should be produced for niche audiences to support other activities rather than as an end in themselves. For dissemination videos, in contrast, view counts can be used as a good indicator of failure or popularity, although translating popularity into impact is not straightforward.

Introduction

Some academics are taking advantage of the web to publish pictures, videos, presentations, and other things that previous generations may not have produced or may have shared with a limited circle of students or colleagues. In theory, these extra resources should be valuable to the scientific enterprise and attempts have been taken to assess the impact of non-standard academic objects such as presentations, blog mentions, syllabuses (Kousha, Thelwall, & Rezaie, 2010b) or scientific images (Kousha, Thelwall, & Rezaie, 2010a). Moreover, innovative outputs may help to communicate and progress science in new ways. Nevertheless, researchers devoting time to non-traditional content production may not be appropriately recognised or rewarded because their products may be excluded from standard evaluation information (e.g., citations, prizes and grants). It is therefore important to assess the value of new types of publishing and develop mechanisms to evaluate individual contributions.

This article focuses on online academic videos in YouTube, about which there is surprisingly little research. Video production is increasingly simple with modern digital video cameras or mobile phones and editing suites. The results can be easily shared on popular sites like YouTube. One example of an innovative video-based scholarly initiative is the Journal of

Visualized Experiments (JoVE, http://www.jove.com/). It publishes videos of biological, medical, chemical and physical research experiments as scientific outputs in a journal format. The Journal of Number Theory also puts YouTube video summaries for some published papers at the end of their abstracts (see http://www.youtube.com/user/JournalNumberTheory). These examples show that online videos can play useful roles in science communication, even though a recent study found that only 0.3% of articles by UK academics contained any types of web citations (Creaser, Oppenheim, & Summers, 2010). Nevertheless, educational TV programmes are used by both schools and universities, suggesting that videos may have a role in science education.

Although there do not seem to have been any general evaluations of online videos for science, they have been analysed for specific health issues (see below). A problem for evaluating non-traditional outputs is that, unless they are cited in academic publications, a new way of assessing their impact must be developed and evaluated. In some cases, such as free online software and data, this problem may be solved by authors requesting users to cite specific publications in return for free use. Another approach is to harness usage statistics, as can be done for electronic articles (Moed, 2005), as a natural measure of value. A problem with usage statistics is the need for benchmarking data so that a given usage figure can be identified as good or bad. Some scientists have therefore argued for the need for mechanism to evaluate the success of academic YouTube projects (Haran & Poliakoff, 2011a). This article assesses academic videos in YouTube to discover what kinds are produced, what kinds are popular, and whether it is reasonable to assess the value of online videos through their view counts.

Background

YouTube was created in 2005 and was apparently the third most visited web site in the world in August 2011 (Alexa, 2011). YouTube makes it easy and free for anyone to publicly share a short video - up to 15 minutes for a standard account (Lowensohn, 2010) and according to one report, in one month in the U.S. 14.6 billion videos were viewed in May 2010 (comScore, 2010). The site seems to allow users to post any legal, non-pornographic content but seems to be particularly used for music videos. It has been criticised in the past for allowing users to illegally share TV shows and other copyright content (Holahan, 2008; Latham, Brown, & Butzer, 2008) but some of the most popular videos are amateur (e.g., "Charlie bit my finger - again !", http://www.youtube.com/watch?v=_OBlgSz8sSM, with 371,514,109 views by September 8, 2011). Moreover, amateur productions dominate numerically: "the majority of that content showcases everyday people engaging in uncommon activities" (Landry & Guzdial, 2008). Nevertheless professional content, such as music videos, may dominate viewing.

YouTube videos have been analysed by academics around a wide variety of different topics. These include organ donation (Tian, 2010), online radicalisation (Sureka, Kumaraguru, Goyal, & Chhabra, 2010), comments on war in Iraq and Afghanistan (Andéén-Papadopoulos, 2009) and clinical experiments (O'Rourke, Tobin, O'Callaghan, Sowman, & Collins, in press). There have also been significant investigations about public health and medicine issues, such as smoking (Paek, Kim, & Hove, 2010), H1N1 influenza (Pandey, Patni, Singh, Sood, & Singh, 2010), obesity (Yoo & Kim, in press) and tanning bed use (Hossler & Conroy, 2008).

Educational videos

In addition to entertainment-oriented content, YouTube contains many serious videos in its Education and Science categories. It has probably been exploited by many amateur and professional educators and scientists to share videos with specific groups (e.g., a class) or the world. Many educators have discussed the possibilities for using YouTube to help teach students (Burke & Snyder, 2008; Desmet, 2009; Skiba, 2007; Trier, 2007). Others argue that the value of YouTube is exaggerated for teaching because it is not a natural environment for education (Juhasz, 2009). Nevertheless, a study of uses of video in the classroom suggests that it can be used effectively for education, including short online clips from YouTube, if some guidelines are followed to ensure a well-designed learning experience (Berk, 2009; Jones & Cuthrell, 2011).

Some scientific projects focus on producing YouTube content alone. For instance the three related YouTube channels, SixtySymbols (physics and astronomy), NottinghamScience (the day to day work of scientists) and PeriodicTable (chemistry) (Poliakoff & Haran, 2009) are produced by UK research council-funded projects and involve practising scientists and a professional video producer (Haran & Poliakoff, 2011b). They aim to give entertaining popular introductions to aspects of chemistry (PeriodicTable, SixtySymbols) or insights into the lives of scientists (NottinghamScience) and seem to be most popular amongst school pupils (Haran & Poliakoff, 2011b). In comparison to traditional educational TV shows, these videos are shorter, probably more entertaining, and do not give a specific educational message to fit in with a known syllabus. A teacher using the videos reported, “They are short and to the point. Our students enjoy watching them” and the video producers believe that the viewers “accompany [the non-chemist producer of the videos] on his exploration of chemistry, sharing his wonder while being spared the bits he finds boring” (Haran & Poliakoff, 2011b). In this case success seems to be due to a combination of good ideas and a team with the scientific and video production expertise to carry them out well and over a long period of time.

Little is known about the overall extent to which YouTube is used in education. One survey found a particularly high use amongst health educators in one US university, with about 42% of the faculty surveyed using YouTube (Burke, Snyder, & Rager, 2009). This figure seems too high to be generally true, however. A much lower figure was found in a later study in a German university: only 13 out of 136 surveyed academics claimed to use YouTube in teaching (Weller, Dornstädter, Freimanis, Klein, & Perez, 2010).

Academic videos

The Journal of Visualized Experiments is perhaps the ultimate for scientific video publishing since each video is a citable “article” with an abstract and references. The journal is subscription-based and its videos are clearly made by subject specialists for other subject specialists. The video format in this case seems to be convenient for showing experimental details that would otherwise have been explained in text. It is also possible for electronic journals in many disciplines to allow embedded videos to be used, for example to illustrate methods (Hartley, in press). Moreover, the journal Nature includes video interviews with selected authors and analysis from editors using a YouTube channel (www.nature.com/nature/videoarchive/).

In addition to scholarly communication and education roles, video may be a suitable format for disseminating information about science to the public. This could also make academics more accountable for their work (Young, 2008). YouTube and the web may particularly help academics to reach a wider audience than previously possible (Jenkins, 2007). Science is sometimes presented in a video format on TV via specialist programmes or news stories but YouTube gives scientists the chance to control the production process fully and try different formats.

Lay videos with academic-related content

The web also gives non-academics the possibility to publish academic-related information and to engage with scholars about topics of interest. For instance, the comments sections of religion-related YouTube videos sometimes host debates amongst the viewers (Thelwall, Sud, & Vis, in press). Researchers have also been concerned with the impact of online information in YouTube giving opinions that experts disagree with and may consider harmful. There has been particular interest in the risk of unverified medical videos being posted online (Ache & Wallace, 2008; Hayanga & Kaiser, 2008; Keelan, Pavri-Garcia, Tomlinson, & Wilson, 2007), which may have particularly serious consequences. Nevertheless, there are also videos from members of the public to engage with or criticise academic research projects (e.g., Karki, 2010; see also: van Zoonen, Vis, & Mihelj, 2010).

Impact evaluation for YouTube videos

There does not seem to be a clear way to evaluate the success of an academic YouTube video. An article about one YouTube science video initiative used a variety of heuristics to persuade the reader of its success, including information about its press coverage, a comparison with the number of subscribers to the British royal family YouTube channel as well as a range of viewer and subscriber statistics for the channel itself (Haran & Poliakoff, 2011b). The authors claimed that the impact of the videos could be "best judged qualitatively from the many thousands of comments and unsolicited emails received from viewers" (Haran & Poliakoff, 2011b), but a qualitative approach would not be appropriate for large scale evaluations of the impact of scientific videos from various sources. Another article from the same team demonstrates that all quantitative statistics about their YouTube videos have limitations and concludes that "We contend that the most reliable way [to judge the impact of YouTube videos] may be to read the comments themselves, as well as the many e-mails and occasional letters that viewers send us" (Haran & Poliakoff, 2011a). Clearly whilst this qualitative approach may be perfect for the video creators it is not suitable for comparisons of scholars to judge the overall impact of their work.

Research Questions

Although the objective is to investigate the possibility to evaluate the impact of online videos produced by academics, the focus is on two specific questions. One question relates to success in terms of audience and the other concerns all research-related videos. Together, they are designed to inform a discussion about the main objective.

- What types of YouTube videos are produced by academics for scholarly purposes?
- Which types of YouTube videos produced by academics for scholarly purposes attract the largest audiences?

Methods

The overall strategy was to gather a large sample of YouTube videos produced by academics for scholarly purposes and to conduct a content analysis (Neuendorf, 2002) on the most popular videos and on a random sample of the remainder. Content analysis is appropriate to describe the types of videos involved rather than any pre-existing categories because the information provided by YouTube about videos (e.g., categories, keywords) is insufficient to gain insights into the types produced. A grounded theory (Strauss & Corbin, 1997) approach could also have been used but content analysis seems more appropriate for a pre-defined list of objects to classify.

There is no register of academic-produced videos or a simple way to obtain such a list from YouTube itself. Hence an alternative method was devised, exploiting a convenient source of academic-related information. The Tweets of 589 users related to science and scholarship collected by a science journalist (Bradley, no date) were monitored from January 7 to August 31, 2010 (Weller & Puschmann, 2011). The 410,609 Tweets collected were processed for URLs and the 234,731 URLs found (typically bit.ly or other shortcut URLs) were converted to full URLs, where necessary, and 4,282 YouTube URLs were extracted.

The YouTube list of URLs from Twitter was filtered to remove duplicates and then submitted to the YouTube API (http://code.google.com/apis/youtube/overview.html) via the Webometric Analyst (http://lexiurl.wlv.ac.uk) software to extract the view count, keywords and descriptions for each video. The list of videos and associated videos was then given two orderings: descending order of popularity (view count) and random. A content analysis was conducted on the videos in both orders separately until the first 100 videos had been classified, after eliminating irrelevant videos. Random videos were excluded if they were also in the list of the top 100 videos. Videos were also eliminated if they were not produced by or based upon an identifiable academic or academic institution. This restriction was made because credit cannot be assigned to unidentified scientists for the impact of their videos. Many videos were also irrelevant to research, including old pop music.

The two lists are expected to have language and discipline biases as well as biases due to the interests of individual prolific scientists within the set. Nevertheless, in the absence of strong alternatives, this seems to be sufficient to give at least indicative answers to the research questions.

The scheme for the content analysis was not constructed in advance because there was no prior research to suggest likely categories. Instead it was designed to accommodate the videos found and adjusted for any new videos found that did not fit the existing scheme. The coding was conducted by the first author using categories that he found appropriate for the data. The results therefore reflect his perspective of the videos, which is a limitation. Once the classifications were complete, the results were checked by comparing the videos within each category and by comparing between categories to ensure that the boundaries were meaningful and consistent. The content analysis was quite time-consuming because of the need to watch each video and the number of irrelevant videos in the list. Moreover, identifying the video producing academic was rarely straightforward. In most cases the video was anonymous or identified by a cryptic YouTube channel name and investigations were needed to identify the academic producing or featuring in the video (if any). No distinction was made between producing and featuring in a video, as long as it was clearly associated with a named academic or academic institution then it was kept in the classification lists. A full list of the videos and classifications is available at: http://cybermetrics.wlv.ac.uk/paperdata/ScienceYouTube.xlsx.

Results

Tables 1 to 3 report the results of the classification of the two data sets. Table 1 is the main classification: the purpose of the video. Unfortunately, many of the videos did not have a clear intended audience or a description of their purpose in YouTube. These videos were mainly demonstrations of a particular phenomenon and were organised into a separate category (the largest). The largest clear purpose for videos was to disseminate research-related information to the general public or to the informed general public (27%). This purpose was most prevalent for the top 100 videos (36% compared to 18%), presumably because of the larger audience for general videos. Education videos were also common (18.5%) and about as numerous as videos designed for academics (17%). The latter were rarely popular (9% in the top 100 compared to 25% in the random set), presumably due to the small specialist target audiences. A small number of videos (7%) were about the life of scientists but these were rarely popular. Finally, there were three popular comedy videos.

As a side note, many of the excluded videos were of interest to scientists but not made by scientists. Several were examples of natural phenomena captured by members of the public, such as animals, animal activities, atmospheric conditions, but others included amateur scientific experiments or material made by teachers for school use or by educated technical employees with academic expertise.

Table 1: Classification of the overall purpose of videos in the top 100 set and the random 100 set.

Purpose	**Description**	**Top 100**	**Random 100**	**Total**
Scientific demonstration	Scientific demonstration of a particular phenomenon (e.g., robot motion, rocket, art animation, geographic feature).	30	28	58
Public dissemination	Public lecture, TV show or video designed to give research-related message to the general public or the informed general public.	36	18	54
Education	Describing a specific scientific phenomenon in non-technical language with an educational aim.	20	17	37
Talk to academics	Presentation to an academic audience (e.g., at a conference).	9	25	34
Inform about scientists	Showing how scientists work to a non-scientific audience.	2	12	14
Comedy	Primarily designed for humour, but with an academic theme.	3	0	3

The videos were classified for the format used to give insights into this aspect of their production (Table 2). A significant number of videos were edited collections of shots (32.5%), signifying a production process and editing work. These were disproportionately in the top 100 set (44% compared to 21% for the random set). A further 13.5% were animations, also signifying effort going into the production process, but these were not disproportionately popular. The three simplest formats are probably lecture (16.5%) and talking head (10.5%), with the latter being rarely popular.

Table 2: Classification of formats of each video in the top 100 set and the random 100 set.

Format	**Description**	**Top 100**	**Random 100**	**Total**
Montage	Edited collection of different types of shots	44	21	65
Lecture	Conference or student lecture	17	16	33
Animation	Animation	12	15	27
Talking head	One person in the video, with or without props, but not explaining object	4	17	21
Live explanation	Explanation of an object, containing explainer and object	5	12	17
Interview	A scientist being interviewed about science.	6	7	13
Experiment	Film of an experiment	5	7	12
Life	Live phenomenon, such as birds	5	3	8
Art	Demonstrating an artistic effect	2	2	4

Table 3 reports the subject areas represented. These are not reported in terms of disciplines because the largest are, space science, overlaps multiple disciplines and videos about it seemed to be about space science rather than astronomy, engineering or physics. A wide range of topics are represented, with computer science and art seeming to be disproportionately represented in the top 100 collection and maths in the random collection.

Table 3: Subject area or discipline of each video in the top 100 set and the random 100 set. Areas with only one video are excluded: Administration, design, education, marketing, public health, and sport all had one top 100 video and botany, government, linguistics, marine science, materials science, and pharmacology all had one random 100 video.

Subject area or discipline	**Top 100**	**Random 100**	**Total**
Space science	13	17	30
Biology	7	11	18
Physics	10	5	15
Computer science	10	4	14
Maths	1	12	13
Chemistry	7	5	12
Zoology	4	8	12
Geology	2	7	9
Astronomy	6	2	8
Psychology	4	2	6
Art	5	0	5
Health	1	4	5
Theology	4	0	4
Science	1	3	4
Media	2	1	3
Philosophy	2	1	3
Environmental science	1	2	3
History	1	2	3
Neuroscience	1	2	3
Medicine	0	3	3
Science journalism	0	3	3
Anthropology	2	0	2
Engineering	2	0	2
General	2	0	2
Geography	2	0	2
Library science	2	0	2
Sociology	2	0	2

Discussion and conclusions

As mentioned above, two key limitations of the approach were the use of a single coder and the origins of the URLs. Although the URLs were extracted from 589 scientists' tweets, these were all selected by one person and may reflect his interests to some extent. This seems to be particularly likely to influence Table 3. Hence the results should be taken as indicative rather than definitive.

A key issue is whether it is meaningful to use the view counts of the videos as indications of their value. For the two data sets, these vary enormously, from 23 (a maths education video) to 13,484,924 (a philosophy of life lecture given by a terminally ill computer scientist). This variation does not seem to be a reasonable reflection of the value of the videos concerned but to reflect a combination of the potential audience size for the topic, the quality of the video, and whether it "goes viral". In particular, it would not be fair to compare the view counts of videos with different natural audience sizes. To give an extreme example, a video designed to demonstrate an intricate experiment to specialists in the field might be a success with only 23 views but this figure would be poor for a video aimed at being accessible to all school pupils.

It seems that view counts on videos for small specialist audiences should be ignored because small numbers are easily manipulated in YouTube and audience sizes are hard to calculate exactly and so it would not be practical to develop a method to accurately assess impact based upon view count. Instead, these videos could be regarded as supporting other scientific activities that might have measurable outputs. For instance, if a video demonstrated a phenomenon explained in a journal article, then the result of the video might be extra citations accruing to the article, which could then be measured.

For videos with large audiences, it seems more reasonable to assess their impact via their view counts, but this would be an inexact process because it would be hard to disentangle the real impact of videos from their entertainment value. For instance, the video, “Lady Gaga's "Bad Romance" played on the Iowa State University carillon” (http://www.youtube.com/watch?v=5cLrAJawSfg) has a clearly impressive view count (709,003). This high figure may be for its novelty and comedy value more than its contribution to art and it is unclear how much contribution is made to music as an academic discipline from these viewings. Hence, a rule of thumb might be to accept that low view counts for videos with large potential audiences is a reliable indication that they have failed but that high view counts are a reliable indicator of attention but not a reliable indicator of a particular type of impact.

When evaluating impact, it should be recognised that different types of video have different types of impact. Table 4 summarises the broad types of impact for the different video purposes from Table 1.

Table 4: Type of impact for each video purpose.

Content	Type of impact
Scientific demonstration	Scientific, educational, public understanding of science
Public dissemination	Public understanding of science
Educational	Educational
Academic talk	Scientific
About scientists	Public understanding of science
Comedy	Entertainment

Finally, do the results give insights into what makes a scientific video popular in terms of large numbers of viewers? Clearly, the first goals should be to appeal to a large audience and not a specialist group, if this is the goal. Second, despite the success of NottinghamScience, videos about scientists at work seem to be rarely popular. Videos seem to work best if they have good production values, such as editing different shots together rather than keeping to a single format, such as a lecture. Finally, the most popular videos seem to have an unusual angle and to be entertaining as well as informative.

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